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## ORNAMENTAL DRAWING
## ADVANCED ARCHITECTURAL DRAWING
## HISTORY OF ARCHITECTURE
## ARCHITECTURAL DESIGN

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# ORNAMENTAL DRAWING

## INTRODUCTION

**1.** The existence of ornament in architecture and the technical arts antedates all written history. One of the strongest characteristics of even the most savage tribes is their attempt at ornamental design, expressed in rude carving, or in the painting of their bodies, weapons, and utensils. To this instinct may be ascribed the habit of tattooing practiced by many uncivilized nations, whereby they essayed to increase the expression of terror of countenance, and create what appeared to them an additional beauty. Uncivilized man has always been a *warrior*, and as such he ranked with his fellow man according to the bravery he exhibited before his friends, and the fear with which he inspired his enemies, and for this reason nothing appeared beautiful to the savage, unless it possessed some element of the terrible or the supernatural. As man becomes civilized, we find his tendency in ornamental design leans toward the reproduction of natural forms, and his self-glorification gives way to the desire to glorify the works of his Creator. Therefore, in the most refined examples of ornament, we always see some attempt to combine in the design some form from the animal or vegetable world, suggestive of the beneficence of Providence.

Ornamentation is thus seen to precede architecture historically, but it was the *art of building* which afforded the grandest field for its development and application. The noblest achievements in the technical arts, reveling in the

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choicest ornamentation, have been produced in the service of architecture; and in all art industries wherein ornamentation seems to follow an independent existence of its own, its products are in harmony with the contemporary taste and tendency of architecture.. The historical style and development, and the technical execution of ornament, whether carved or painted, are thus seen to be inextricably interwoven with the history of architecture and the sister arts.

**2.** To draw an object is to represent it with all its characteristic features, and it would thus appear that, to teach the *drawing of ornament* in a comprehensive way, we should at the same time teach all about its design and application; but experience has proved that such a course complicates the work of elementary instruction, and is only adapted to those who have already learned to draw well and who know something about design in general. The subject must be divided, and for those who just enter upon its study it is best to first learn *how to draw*, and nothing more.

This is the scope and aim of this Paper. In a series of carefully graded exercises, the student is led from the simpler forms to the more difficult ones, and the lessons are confined strictly to *outline drawing*, the object being to develop, in the shortest possible time, such ready facility of the hand and judgment of the eye as will enable him to correctly draw any ornamental outline whatever. Shades and shadows are omitted entirely, as being unnecessary for this purpose, as their representation may be learned, at a later stage, by drawing from casts or models, rather than from copy.

Notwithstanding this program of making this course essentially one of *drawing lessons*, the text is enriched with *incidental* explanations of the ornament presented, to stimulate the student's interest in his work. Information thus obtained, though incomplete and unsystematic, gradually *grows together* in the student's mind, and enables him to more readily comprehend the subject he has in hand.

**3.** Ornament is either the embellishment of a structural feature, accentuating its form and purpose, in which case it is usually carved or molded *in relief;* or the ornament consists of a flat surface decoration, such as a carpet pattern, wall paper, or painted design. Ornament consists of a combination of straight and curved lines, independent or joined with vegetable or animal forms, or exclusively of the latter—with or without color decoration. Some ornament is purely geometrical in character, and can be drawn entirely with instruments; another is partly freehand and partly geometrical work; and the remainder is entirely freehand work. Ornamental drawing includes the rendering of **form** itself, being the representation of those graceful lines which exist in the animal and vegetable world, and also those of man's own invention, as seen in the architectural moldings, in the sweeps and curves of furniture, in the scrolls and twists of wrought-iron work, and in the outlines of pottery, glassware, cutlery, vehicles, ships, machinery, etc. For instance, in an ornamental vase or wrought-iron grille, the general *form* and the graceful lines and proportion of its parts are as much subject for **ornamental drawing** as is any individual *ornament* with which a part of either of these objects may be decorated; but the drawing of animal or human figures, and landscape sketching, are separate branches of art.

**4. How to Draw.**—The making of a drawing can be said to consist of two parts, namely, the making of the individual lines, and the making of the composition. Straight and curved lines must be drawn *in strokes*, and not in dots or in a succession of short scratches. The strokes must not be jerky or detached, but *continuous*, each one being a continuation of the preceding one, and as long as one unconstrained movement of the finger joints will make them, which is about 1 inch. No other method maintains so well the *direction* of the lines to be drawn, nor develops so readily the pliability of the hand and the judgment of the eye by fastening the attention of both upon the making of a continuous line, instead of upon the making of *pieces of a line.*

In ordinary drawing, the elbow may be rested on any part of the drawing board, as the case may require; but the ball of the hand should be as free as possible, in which position the hand will rest and travel along lightly on the first joint of the little finger.

The pencil recommended for use is one corresponding to grade "S M" of Dixon's pencils. For aiding in the work, a *soft waffle rubber* may be used to advantage, to clean up the drawing after the sketch is complete, and just previous to the process of inking in. The final pencil lines must be firm and clean, but not heavy; and, if any corrections are necessary, an ordinary *white Faber's rubber* should be used. The student should keep a uniform round pencil point, of medium length, and avoid continued sharpening, but maintain a good point by turning the pencil as he works. Avoid cheap pencils; they are a delusion as to economy, and their common lead smears up the drawing. Three golden rules to be observed by the student are: *Never wet the pencil; never use a hard pencil; never use a short pencil.* The pencil never should be less than 5 inches long, in order that it may rest against the knuckle of the forefinger.

The *eye* must guide the hand in drawing, but should not be riveted too closely upon the pencil or drawing pen; a glance forwards and backwards over the work, to compare the *form* of the design and the direction of the lines, will enable the student to keep his work close to the copy, which is all that is at present desired.

The draftsman, sitting at work, should avoid bending over the drawing in a cramped position, as it is likely to injure his eyesight, and will in no way benefit his work. An easy, natural attitude is the best. All subjects should be outlined in their normal aspect, not upside down or sideways, the paper being straight in front of the draftsman; but, in the final rendering, especially in the inking, there is no objection to turning the sheet or the body around, to make the work more convenient and thus produce perfect lines.

**5. Composition.**—The second element of a *drawing* is the composition, which, in this case, means the general grouping of the lines of the design, according to the size or scale to which the drawing is made.

Before beginning to draw a figure, its *general effect* and characteristic shape *as a whole* should be carefully observed. The individual forms, the curves and scrolls, and the cut of the foliage should then be studied, and its symmetry and the proportion of its parts, and the direction of its movement, should be borne in mind during the entire process of sketching it in. As to the *size* of the drawing in relation to the copy or model or natural object, it is sufficient to say that some definite scale of enlargement or reduction should be followed, so that everything shall be maintained in *equal relative proportion.* In beginning to draw a figure, first lay off the extreme size of the ornament, then locate all the principal points of extent and position, by measuring from the base and center lines, or by a network of rectangles, as explained hereafter. For this measuring and locating, *extreme exactitude is not required;* there should, in fact, be as *little* mechanical measuring as the student can get along with, all minor details being gauged by the eye. Use the *eye* as much as possible, in order that it may become trained to judge correctly of absolute and relative sizes, of form and proportion. The value of this accomplishment to the draftsman and designer cannot be overestimated. Since the object of the student is to learn *to draw*, and, in a measure, to obtain a knowledge of ornament, the above points are of far greater importance to him than the mere act of repeating or copying of lines, and the purpose of this course is not to make copyists of the students, but to make draftsmen and designers of them.

The same spirit applies to the drawing of the *two halves* of any symmetrical ornament. Except in the main points of the design, no absolute identity of the two halves is to be attempted; there is no artistic necessity for such, either in drawings or in executed work. If some little inequalities appear in the two halves of some scroll or foliage work, leave them alone, and remember that good ornament is enhanced in value, rather than depreciated, by the absence of constraint or of stiff regularity. The individuality of the designer, carver, or painter shows itself in such matters, and gives character to his work.

There is another *very important* point to be observed in the drawing of symmetrical figures. Never draw one half complete by itself and then the other half; lay the whole ornament out *as one figure* and finish it up simultaneously. Above all, *never trace off* one half of an ornament to produce the other half. This method of working is permissible in offices and shops, on the part of experienced draftsmen, but must be *absolutely avoided* by the student. Let him remember that he is learning *to draw*, and nothing will train either hand or eye as well as constant practice and redrawing the same thing.

## THE PLATE EXERCISES

**6.** The plates are to be drawn on the same size paper, 14 in. × 18 in., as was used in *Geometrical Drawing*. Unless the student has already had practice in freehand drawing, he should draw each of the exercises three or four times before he attempts the plate he will send in to the Schools for correction. This preliminary work need be drawn in pencil only on a good quality of brown paper that will withstand rubbing. Draw all the figures of one plate complete before beginning to ink them. For freehand work, use a Gillott's No. 404 pen in a smooth, round, long holder without swell or taper. In regard to *curves*, it is generally best and easiest to ink them freehand, but in some cases, which will be pointed out as we progress in the work, they may be inked in with instruments by combining arcs of circles with the lines of irregular curves.

When inking in, keep the hands and tools clean, wipe the pen frequently, and keep the ink bottle corked to exclude dust. When using stick India ink ground on a slab, occasionally add a drop of water to keep it of equal shade and fluidity.

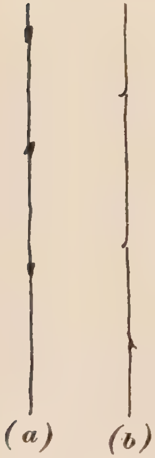
**7. To the Student.**—We realize that this work goes out to young men of varying degrees of ability, diligence, and opportunity; the exercises which will appear simple to one will prove difficult to another. To those of decided natural ability we say: Be diligent; keep at it in the regular order; do not think too soon that you know it all, or that you can disregard our instructions, or become careless. To those others whom nature has not so kindly endowed, but who have an earnest desire to learn, we say: Be not discouraged by early difficulties; you are learning every day; your hand is becoming more supple and your eye more observant with each new exercise; try to realize that you are studying not only a useful but an artistic and also a difficult accomplishment, something worthy of your greatest efforts and unswerving perseverance. These staying qualities, joined to but a medium grade of talent, often succeed where greater abilities, joined to indolence and restlessness, result in failure. It sometimes takes years for the child to learn to write, but he finally learns; while the adult, better appreciating the value of the accomplishment, may acquire the same knowledge in a few months. Patience, perseverance, and constant practice are necessary in all cases, and he who can learn to write can learn to draw, as the principle is the same in both accomplishments.

## DRAWING PLATE, TITLE: LINES

**8.** The exercises on this plate are to be drawn by the student to train his eye and hand to work together, and thereby become sufficiently practiced to execute the designs that follow. The drawing of a single line is of as much importance as the execution of an entire design, and the student must practice constantly and patiently, until he masters each simple problem, before he attempts the next.

In Fig. 1 is shown the method of drawing perpendicular straight lines. The pencil should be held lightly between the thumb and the forefinger with its upper end resting against the finger between the second and the third joint, while the end of the middle finger rests on top of the pencil alongside of the forefinger, and not underneath the pencil, as is sometimes erroneously done in writing.

The drawing board should be squarely in front of the student, and his elbow should rest near the bottom of the board, somewhat to the right of the drawing he is at work upon. A short straight line is then drawn, as from *a* to *b* in Fig. 1, and the arm is then shifted a little lower down on the board, and another line, as *b c*, is drawn, care being taken that there is a space of at least $\frac{1}{32}$ inch between the end of the line *a b* and the beginning of the line *b c*. A third section of the line is then drawn from *c* downwards, and so on, until the line is of the desired length. Having practiced this several times, the student should gradually decrease the spaces between the sections of the line until it appears as a straight unbroken line, as shown at *d e*. It is necessary to be still more careful in doing this, lest the lines overlap one another or curl out at the ends. The former error causes the finished line to appear somewhat as at (*a*) in the figure shown on this page, while the line composed of strokes whose extremities are curled would appear ragged, as at (*b*). The strokes with which these lines are made are not short quick dashes of the pencil or pen, but slow, even marks, each of which is started carefully, drawn slowly, and finished abruptly, so as to show a clean, even stroke, the same weight and color throughout, and clean cut from end to end. The second stroke must never lap over the first, and it is better to let a hair-breadth space remain between the ends of the lines than to have the least suggestion of a line like (*a*). When the student has acquired proficiency in this exercise, he may draw four perpendicular lines on his paper $\frac{3}{4}$ inch to the



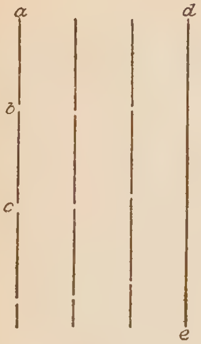
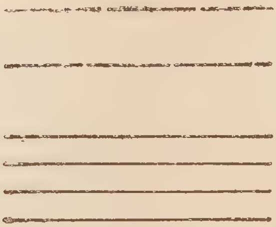


Fig. 1.



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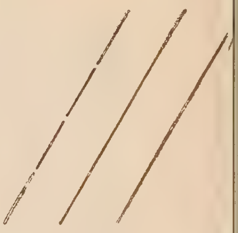

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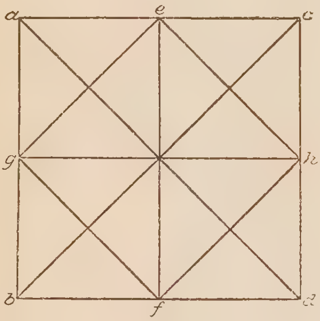

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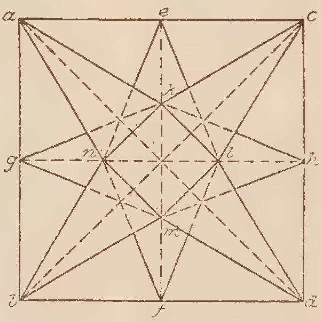

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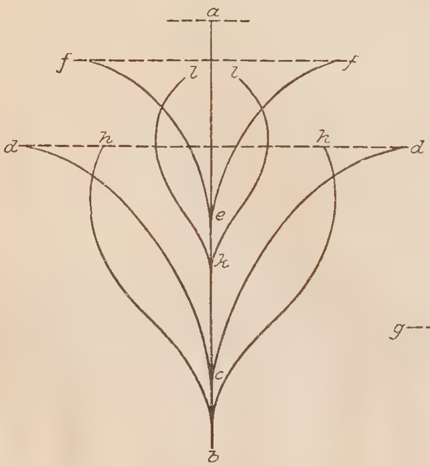

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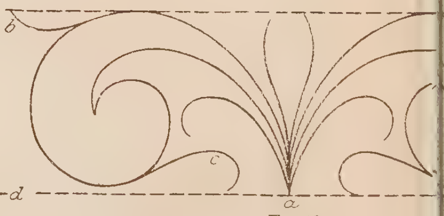

Fig 13

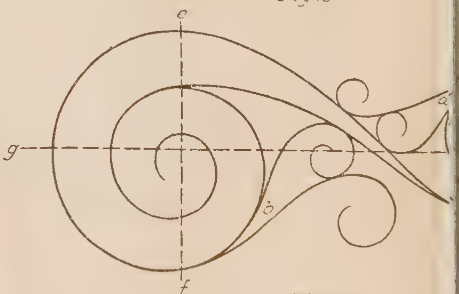

Fig 14.

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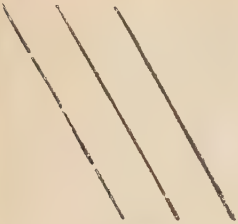

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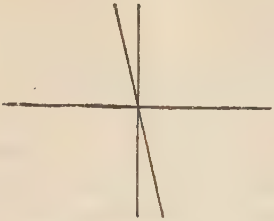

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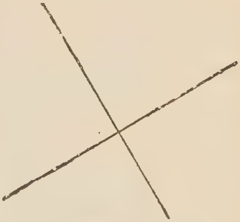

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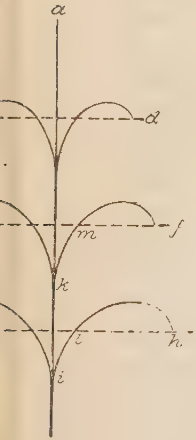

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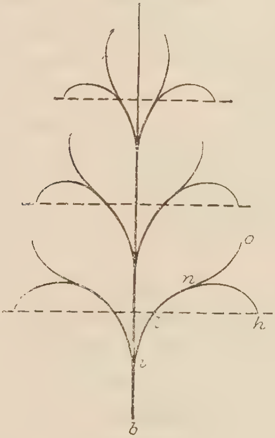

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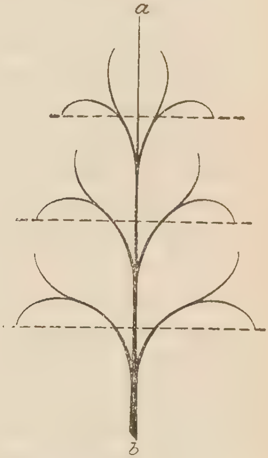

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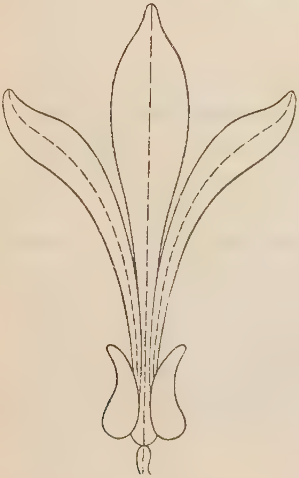

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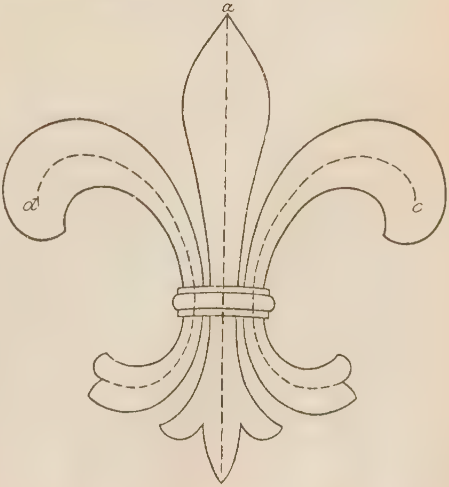

Fig 16.

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right of, and 1 inch below, the side and top border lines, respectively, these four lines to be $2\frac{3}{4}$ inches long, and spaced $\frac{1}{2}$ inch apart. Only one of them need be an absolutely solid line, the other three being composed of dashes about $\frac{3}{4}$ inch in length.

The drawing of horizontal lines should now be practiced in a similar manner, except that the elbow should be drawn near the body, and, when the strokes forming the horizontal lines are drawn, the whole arm should be moved towards the right, in order to prevent the lines from becoming arched, as would be the case if the elbow remained fixed, and the hand was moved only so far as the swing of the arm would permit. The strokes forming the horizontal lines may be somewhat longer than those composing the vertical lines, but the method of forming one straight line, by the careful union of several smaller ones, remains precisely the same for both cases.

In drawing the horizontal lines, see that perfect parallelism is maintained; the spacing between the lines, however, may be gradually increased or decreased in order to better train the eye as well as control the hand. In drawing Fig. 2 of the drawing plate, commence 1 inch below and $2\frac{3}{4}$ inches to the right of the upper and left-hand border lines, respectively. Make the upper two lines $\frac{1}{2}$ inch apart, the third line $\frac{5}{8}$ inch below these, and the lower three lines $\frac{1}{4}$ inch apart and $\frac{1}{4}$ inch below the third line—all the lines being $2\frac{1}{2}$ inches long.

Figs. 3 and 4 show two sets of parallel oblique lines, the former being drawn from right to left, and generally called *right-oblique* lines, and the latter drawn from left to right, and usually designated as *left-oblique* lines. Fig. 3 is much easier to draw, as the slope of the lines corresponds in direction to the inclination of the letters in ordinary handwriting, and the hand is more accustomed to the angle. After practicing the right-oblique lines, until the student feels assured he can do as well with them as with the two previous sets, he should draw a series in the direction shown in Fig. 4. To do this it will be necessary for him to change the position of his arm, so as to bring the elbow towards the right end of the board and the hand above and to the right of the lines to be drawn. Commence the first line of Fig. 3, 7 inches to the right, and of Fig. 4, $8\frac{3}{4}$ inches to the right of the left-hand border line, and draw the lines $\frac{1}{2}$ inch apart horizontally and 1 inch below the upper border line.

The simple line exercises above described are of the utmost importance to the student, as upon them will depend much of his future freehand work, and constant practice of them cannot be advised too urgently. He should practice each set repeatedly, upon a sheet of ordinary brown manila paper, until he feels confidence in his ability to produce, at will, perpendicular, horizontal, or oblique lines; and then, but not till then, should he attempt to draw them upon the sheet which he will send to the Schools for correction. Each of these exercises should be drawn as carefully and as accurately as though it were part of a complicated design—haste will only produce slovenliness and impede the progress of the student to the end he seeks to attain in this course—namely, that of becoming a good draftsman. *Neatness*, *accuracy*, and *rapidity* are the three qualifications of a good draftsman, in the order of their importance, and the last is of no value unless accompanied by the other two, while the second is impossible without the first.

Figs. 5 and 6 show a combination of intersecting straight lines, Fig. 5 showing a horizontal line crossed at its center by a perpendicular line, thereby forming four angles of 90 degrees each, while an oblique line passes through both of them at their point of intersection, at an angle of about 13 degrees with the perpendicular. The eye must therefore learn to judge the inclination of a line, as well as its length and parallelism with another line, as there are many instances where the accuracy of this judgment will determine the value of a finished design. In Fig. 6 both of the intersecting lines are oblique lines, but they are perpendicular to each other, and though very simple in appearance, this problem is quite difficult to execute with accuracy. The student should practice this exercise repeatedly, testing his drawings with a triangle to determine the accuracy of his work; while in different trials the lines should be inclined at different angles, and care always exercised to be sure the second is perpendicular to the first. The points of intersection in Figs. 5 and 6 are 4¼ and 1¾ inches from the right border line, and the lines extend to within 1 inch of the upper border line.

Fig. 7 shows a combination of the problems involved in Figs. 1, 2, 3, and 4. Two vertical lines *a b* and *c d* are first drawn, each being about 2½ inches in length and spaced 2½ inches apart. Two horizontal lines *a c* and *b d* are then drawn, thus forming a square *a b d c*. From the center of *a c* a perpendicular line *c f* is drawn till it intersects *b d*, and from the center of *a b* a horizontal line *g h* is drawn till it intersects *c d*. Two right-oblique lines are now drawn from *e* to *g* and from *h* to *f*, and two left-oblique lines from *e* to *h* and from *g* to *f*. The diagonals of the square *c b* and *a d* are now drawn and complete the figure.

In laying out the sides of the original square *a b* and *c d*, the student should make the measurements by the eye, without using any scale or other mathematical instrument. It is a simple matter to space two dots 1 inch apart, and then a third one, an inch from the second, and a final dot ½ inch from the third, making a total length of 2½ inches over which the line is to reach. In this way the eye is at first trained to judge only 1 inch of length; but, by constant practice, any measurement may be laid off by the eye, with a degree of accuracy that is surprising.

Fig. 8 shows a combination of all the preceding problems. A square *a b d c* is first laid out, in the same manner as in Fig. 7; its vertical and horizontal subdivisions *e f* and *g h*, however, and its diagonals *a d* and *c b*, are dotted in this case, while the interior square *k l m n* is drawn with the vertical and the horizontal dividing lines of the larger square as its diagonals. The interior square is only 1 inch in length on these diagonals, as from *k* to *m*, or *l* to *n*, and its sides *k l*, *l m*, etc. form the bases of four isosceles triangles, whose vertices are in the corners of the larger square; while the diagonals of the smaller square form the bases of four other triangles, whose vertices are at the center of the sides of the exterior square.

The sides of this second set of triangles are dotted after they intersect the sides of the first set, thereby showing only the upper part in full lines. There should be no difficulty in drawing this figure, except in the adjustment of the measurements. The large square is $2\frac{1}{2}$ inches on its sides, and the small square is 1 inch on its diagonals; and, if these dimensions are laid off accurately, the remainder of the exercise is only a matter of drawing straight lines between two points. In drawing these figures, the student need not necessarily dot all the construction lines when he pencils in the work; but when the inking is done, he must be careful not to draw a full line where a dotted line is required, as the subsequent erasure will impair the neatness of the finished work, much more than in instrumental drawing.

In inking in lines, the pen is held in precisely the same manner as the pencil, and the strokes composing the lines are made with the same slow, careful movement as when the work was first laid out. Dotted lines are made in the same manner as full lines, except that the strokes composing them are not more than $\frac{1}{8}$ inch in length, and the spaces between them not less than $\frac{1}{16}$ inch. The pen should be wiped clean and dry before each immersion in the ink, in order that the lines may be of uniform thickness and color. In this style of freehand drawing there should be no attempt at shade lining, as in geometrical drawing, and each line should have exactly the same weight and strength.

Curved lines are drawn with full, even strokes in the same manner as straight lines, the position of the hand and forearm being slightly varied according to the direction of the curve. In drawing curved lines, as much of the motion as possible should be given by the wrist, and the forming of any part of the curve by the fingers alone should be avoided.

Fig. 9 shows a combination of straight and curved lines as we find them in the simple forms of foliated work. The perpendicular line *a b* is first drawn about $3\frac{3}{4}$ inches long, and divided into four equal parts; through each point of division the horizontal lines *g h*, *e f*, and *c d* are drawn. The curves *i l h*, *k m f*, etc. are then drawn, the amount and extent of their curvature being gauged solely by the eye. The left side should be drawn first, so that the position of the hand will not interfere with the view of the opposite side, as would be the case if the left side were drawn last. Draw the curves in pairs, one on the left side and its mate on the right, constantly comparing the curvature with the original drawing to insure its proper proportion. When the figure is complete, the curves and the perpendicular may be inked in, but the horizontal guide lines should be erased.

In Fig. 10 we have a continuation of the exercise shown in Fig. 9, a number of additional curves being executed, which carry the form further towards a foliated design. These extra curves must be tangent to the first ones, and are of the same length as that part of the original curve beyond the point of tangency. The curve *h n l i* is tangent to the straight line at *i*, while the curve *n o* is tangent to the first curve at *n*, and is the same in length as the curve *n h*. Either *n o* or *n h* could be removed from the figure and leave a perfect curve in *l n h* or *l n o*.

In Fig. 11 we have the completed skeleton of the foliated form started in Fig. 9. It will be observed in this figure that the main stem *a b* is heavy at the bottom *b* and gradually tapers off to a hair line at the top *a*, while the curves that branch out from it are a trifle lighter or thinner than the main stem, at the point of their tangency, and also taper and split into the two finer lines at the end.

**9.** The three figures last drawn illustrate the three fundamental principles of foliated ornament:

1. *All lines should radiate from a parent stem;* as in Fig. 9, where *a b* is the parent stem, and the curved lines *i l h*, *k m f*, etc. radiate from it.

2. *All branching lines should be tangent to the line from which they branch;* as in Fig. 10, where the curve *i n h* is tangent to the parent stem, and *n o* is tangent to *i n h*.

3. *There should be a proportionate distribution of areas between the parent stem and the branches;* as in Fig. 11, where the parent stem *a b* has the greatest breadth or area, and each of the branches has an area proportionate to its length and to the position it occupies on the parent stem. These principles should be borne in mind by the student, as they will be exemplified as the work becomes more complex. The bottoms of Figs. 7 to 11 are all $7\frac{1}{8}$ inches below the upper border line, and their center lines are 2 inches, $5\frac{1}{2}$ inches, $8\frac{7}{8}$ inches, 12 inches, and $15\frac{1}{4}$ inches, respectively, from the left-hand border line.

**10.** In Fig. 12 we have a combination of the same curves as exist in Fig. 10, but arranged differently. The main stem *a b* is drawn $3\frac{3}{4}$ inches long, and the points *c*, *k*, and *e* are laid off $\frac{5}{8}$ inch, $1\frac{5}{8}$ inches, and 2 inches, respectively, above *b*. The curves *c d* and *e f* are then drawn so as to be tangent at *c* and *e*, and the curves *b h* and *k l* are drawn to be tangent at *b* and *k* and reverse their direction of flexure, so as to intersect the first two.

Fig. 13 shows an example of ornament composed entirely of curved lines. These lines radiate from a common center at *a*, where they all become tangent, while small branches, as at *b* and *c*, relieve the cramped appearance that might exist if the lines were left to curve unbroken to a common center.

Fig. 14 shows a combination of continuous curves or scrolls, with tangent branchings at *a* and *b*, and is a style of design which is largely used in ornamental ironwork. The spirals require most careful drawing, and may be started on the construction lines *c d*, *e f*, and *g h*. The points where the spirals should intersect the construction lines should be laid off first by *eye measurement*, and the curves then drawn to pass through the points so located. The entire figure should be $4\frac{1}{2}$ inches long, and the right-hand scroll $1\frac{1}{4}$ inches wide, while the left-hand scroll should be $\frac{7}{8}$ inch wider than this.

Fig. 15 is a conventional representation of a flower; the lines are all curved and of double flexure, but the system of construction is simple, as shown by the dotted lines.

The terms *conventional*, or *conventionalized*, are used to designate a floral or other device which has been drawn on a system of geometrical construction lines. For instance, Fig. 15 is a representation of a flower of the lily class, but is drawn so that each half, as divided by the vertical center line, is a duplicate of the other half—a condition which never would exist in nature, but which is desirable in certain classes of ornament.

In Fig. 16 is shown a still more conventional style of rendering the same flower, and this form of it is universally known as the "fleur-de-lis," which is a French term signifying "flower of the lily." The central construction line *a b* is vertical and straight, while the side lines, as *c d*, are curved similar to the side lines in Fig. 9, except that they are not tangent to the center line, but are kept $\frac{1}{4}$ inch away from it and curve out at their lower extremities. The student should not attempt to draw any of the last six figures until he has thoroughly mastered the simpler forms that precede them. Patience and perseverance on this part of the work will render what is to follow not only more accurate but also more simple.

Figs. 12, 14, 15, and 16 are all $\frac{3}{4}$ inch above the lower border, while the center lines *a b* of Fig. 12, and *e f* and *c d* of Fig. 14, are $2\frac{3}{8}$ inches, $5\frac{1}{2}$ inches, and $8\frac{3}{8}$ inches from the left-hand border line, respectively. The center lines of Figs. 15 and 16 are $6\frac{1}{4}$ inches and $2\frac{3}{4}$ inches from the right border line, and Fig. 13, which is $1\frac{5}{8}$ inches high and $4\frac{1}{2}$ inches long, is drawn above Fig. 14 and $3\frac{1}{2}$ inches from the lower border line.

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## DRAWING PLATE, TITLE: VASES AND BORDERS

**11.** In this plate, Figs. 1 to 8 show outlines of various vases and urns, which afford excellent practice in drawing curved lines united to fillets and coves. These may be drawn freehand, or partly with the instruments, but the inking in should be freehand work in either case. The center lines and principal heights and widths are marked on the plate, and the student should use a scale in laying them out in his practical work.

In inking in, the student should be careful that the connecting curves are graceful lines, and tangent to the arcs, so as to form a perfect joint.

The art of pottery and glass blowing, technically called **ceramics,** is as old as civilization, and every ancient race has left an art legacy in this line. The examples from Greece, especially, have to this day remained models of correct form and appropriate decoration. In the fifteenth and the sixteenth centuries, it was in *Venice* that the art flourished and produced works of unexcelled beauty, especially in the art of glass blowing. In more modern times, the great potteries of *Sevres*, in France, and of *Dresden*, in Germany, have furnished the art world with wonders in ceramic design; but at no time have the ancient Greek forms been entirely superseded.

Figs. 9, 10, and 11 show geometrical patterns of frequent occurrence in every kind of ornamentation. Their character is *textile;* they are designs devised from the weaver's skill, and from that origin have been used in every other branch of the technical arts, and in architecture as surface decorations. Figs. 9 and 10, called **frets,** plain and interlacing, were used largely in Grecian architecture and ceramic decorations. Fig. 11 is the same in principle as Fig. 10, but with the lines curved instead of straight. This style of interlaced ornament is called the **guilloche,** and is suggestive of braided work. Both kinds are of countless variety, and with the addition of colors make beautiful ornaments, regarded simply as such. Their design is based upon a network of squares, triangles, or circles, or combinations of these, and they have the character of strictly regular and unlimited repetition.

To draw Fig. 9, divide the height, which is 2 inches, into nine equal parts, and repeat this spacing horizontally so as to form squares, then count off the squares and draw the lines of the figure.

To draw Fig. 10, divide the height into six equal spaces, and

# VASES A

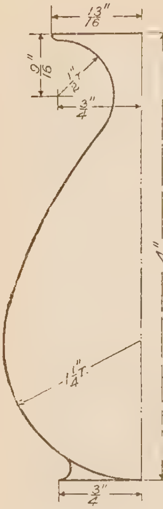


Fig 1.

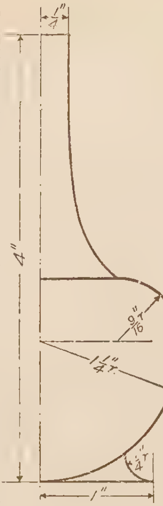


Fig 2.

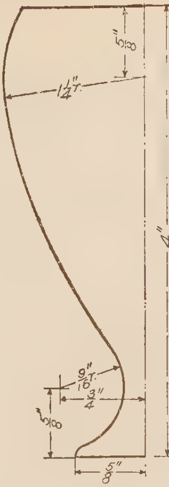


Fig. 3.

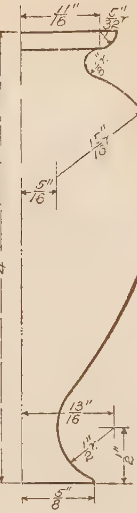


Fig. 4.

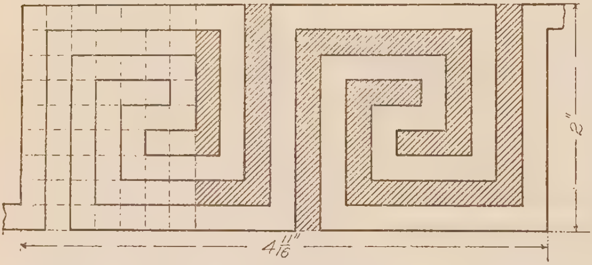


Fig. 9.

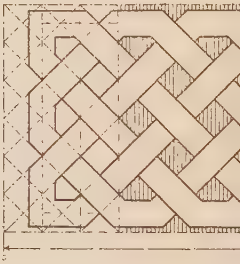
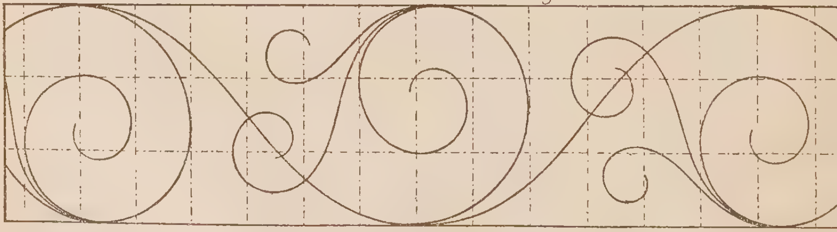


Fig. 12.



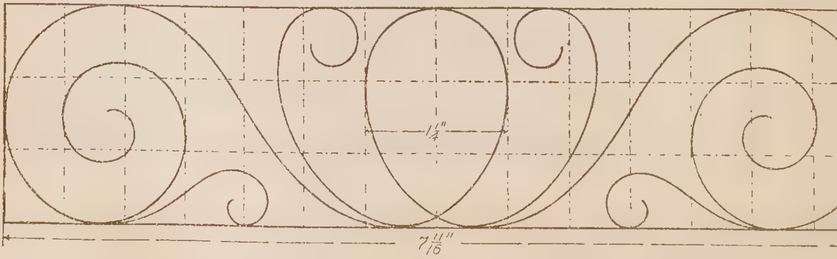


Fig. 13

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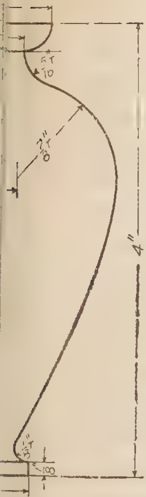
# BORDERS.



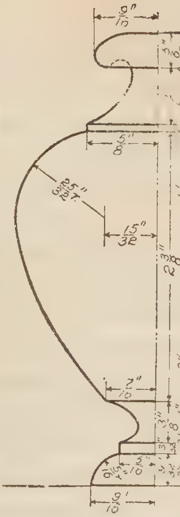


Fig. 6.

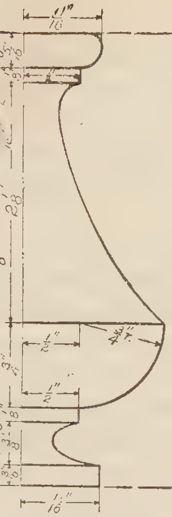


Fig 7

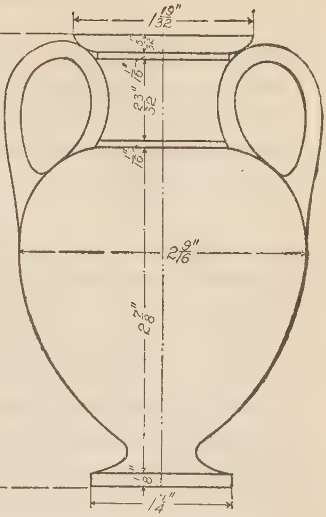
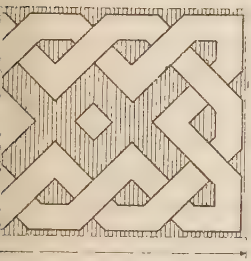


Fig 8.



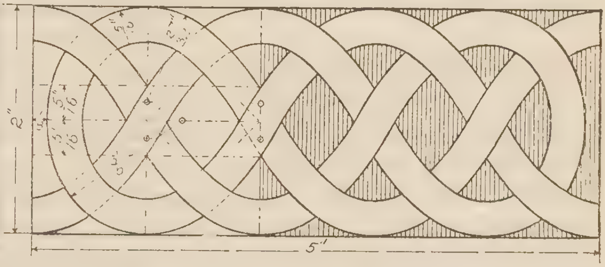
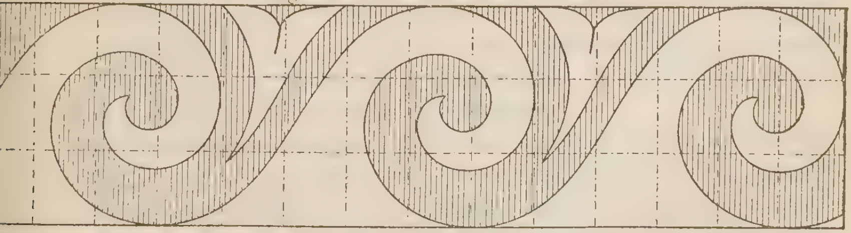


Fig. 11

Fig 14



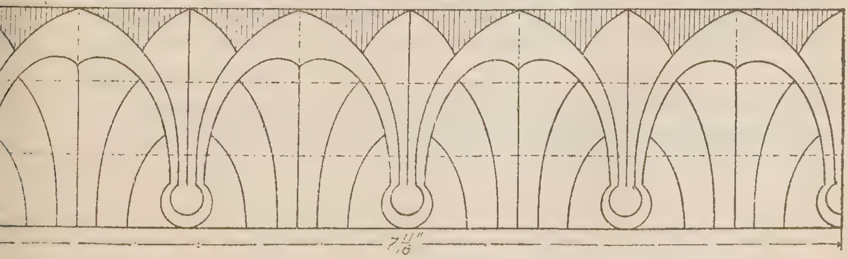


Fig. 15.

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JOHN SMITH, CLASS Nº 4529

repeat the same divisions horizontally. Through the points of intersection draw 45-degree diagonals to form a network of diagonal squares. To obtain the boundary line, draw the width of the band through the first vertical division line, and also through the top and bottom horizontal diagonal lines of the squares.

To draw Fig. 11, divide the length of the panel into five equal vertical parts; also, draw the horizontal divisions as figured. This ornament is to be drawn with arcs and with connecting sweeps made with the irregular curve. Lay off the centers for the upper and lower arcs upon the verticals as marked, sweep them around till they intersect, and from there connect them with two equal curves which are to meet on the short diagonals dotted through the center point. The inner arcs stop against the sweeps of the outer arcs. For the end finish, strike parallel arcs from the intersection of the sweeps on the horizontal middle line as marked. There is no freehand work in Figs. 9, 10, and 11.

Figs. 12 and 13 are **scroll lines,** suggested by the curves of growth of such vines as the ivy, the honeysuckle, etc. As simple line ornaments, scrolls occur in a variety of surface decorations, and in wrought-iron grilles and railings; but their greatest field is in furnishing the basis of the ornamentations known as **arabesques,** which are animated compositions of idealized vegetable life, stems and tendrils, leaves and fruit work, combined in rich profusion with animal and human detail and other accessories. Arabesques are used particularly for friezes, panel and pilaster decorations. Their character as ornaments is purely *decorative*, and offers an unrestricted field for the artist's fancy.

The importance of the scroll line must thus be apparent to the student; it is of constant occurrence in ever-changing form, and he should make special effort to learn its delineation. These scrolls differ from that shown on the previous plate, as the lines are less constrained and have more freedom of flexure.

To draw Fig. 12, divide the height of 2 inches into three equal strips; then take off a vertical strip $\frac{3}{16}$ inch wide at the beginning of the panel, and divide the remainder into fifteen equal parts. These guide lines locate exactly, or very closely, the principal points of the scrolls; for all minor details, judge size and position by the eye, but do not forget the remarks previously made in Art. **5** on the subject of composition.

To draw Fig. 13, divide the panel horizontally as above; from the vertical center line, measure to the right and left a distance equal to the height of one of the horizontal divisions, and divide the remainder on each side into six equal strips. In the pencil drawing of Figs. 12 and 13, the irregular curve may be used for all the larger lines, but the inking in should be freehand.

Fig. 14 is another example of *scrollwork*, the lines being double and terminating in a closed curl. The ornament is distinctly Egyptian in style, and is used largely as a *cresting*, or *crowning* feature of structural parts. It is a characteristic *running ornament*, typifying the waves of the rising Nile, from which Egypt derived so many benefits. It subsequently became a favorite ornament in Greece, where it no doubt suggested the idea of the volute, which is discussed further on. To draw Fig. 14, divide the panel horizontally into three equal parts, and vertically into fourteen equal parts, and locate all needful points, as previously explained. In drawing, the irregular curve may again be used, but the inking in should be freehand.

Fig. 15 is an example of leaves modeled from those of water plants, and, therefore, technically called **water leaves.** They occur largely in all styles of classical architecture, where they are used to decorate moldings, the necks of capitals, the shafts of candelabra, etc. The shape of this leaf varies from broad and blunt to slender and very pointed, with more or less pronounced rib lines. Its edge is usually smooth, but sometimes is indented with a furrowed rim.

To draw Fig. 15, divide the panel into three equal horizontal and eight equal vertical parts; locate the principal points of intersection, judge the shapes well and draw them carefully, inking them in freehand.

All plants do not lend themselves with equal facility to ornamental treatment. Individual and decided forms of leaf, flower, or fruit, good grouping of parts, and a certain adaptability to the exigencies of composition, are necessary. Their forms must offer the possibility of being remodeled, either in the direction of an idealistic treatment or in the opposite one of a naturalistic exaggeration. All plants will not admit of this, and, consequently, we find particular vegetable forms associated with particular styles of design, according to their tendency. Our text gives some applied illustrations on these matters in a general way, but beyond that we cannot pursue this topic at present. Suffice it for the student to know that all vegetable elements of ornamentation are largely artificial creations of man's own invention, and that they must be in harmony with the style and design of the object which they adorn. The delicate arabesques of the Italian revival would look out of place decorating the somber masses of a Gothic tower; likewise, the Gothic oak leaf, with its great bumps and protruding rib lines, would be too coarsely realistic for a Corinthian capital in contrast with the elegant entablature of this order. Ornamentation grows, so to speak, with and out of the style, as do leaves and blossoms out of the stems and branches. Harmony of spirit, form, and purpose is the underlying principle of all art.

## DRAWING PLATE, TITLE: CONVENTIONALIZED LEAVES

**12.** Figs. 1 and 2 represent two conventional styles of leafwork of the class of ornaments known as **palmettes.** There are a number of plants whose leaves or flowers may have first suggested these forms. The leaves with drooping points as shown in Fig. 2 are generally assumed to typify the *lotus*, the sacred water plant of Egypt; the lancet-shaped leaves of Fig. 1 are generally assumed to be derived from the buds of the honeysuckle.

To draw Figs. 1 and 2, lay out the guide lines as marked, and locate the tips of the leaves and a few principal points of intersection; observe the form carefully and draw the ornaments, with an irregular curve, if desired, inking them freehand.

Fig. 3 shows single lobes of leaves patterned after the characteristic cut of the **parsley** and **celery.** Figs. 4 and 10 show corner ornaments, or carved terminations on the return corners of moldings. They are composed of the lancet-shaped leaf of Fig. 1. The general pattern of bell-shaped flowers like those of the tulips and lilies and others is shown by Fig. 8. All the above examples are to be drawn with care, and inked freehand, taking special pains with the converging lines of Figs. 4 and 10.

Fig. 5 is a **running scroll ornament** of conventional design, the scroll having a swell which gives it a peculiar effect. This example may be drawn entirely with the irregular curve, excepting the leaves which fill the spandrels, but should be inked in freehand.

Fig. 6 is a **water-leaf ornament** used largely to decorate a molding known as the *cyma reversa.* This style of water leaf, which was perfected in Grecian architecture, is distinguished by having its edge *rimmed*, or beveled, which is indicated by the double outline, giving it a richer shadow effect.

Figs. 7, 9, and 11 are geometrical **rosettes** composed of plain and rimmed water leaves. Their construction is self-evident, and they must be drawn and inked freehand, though the construction lines may be laid out with instruments.

Fig. 12 is a **scroll ornament** designed especially for practice in this most important line. Lay off all the guide lines as marked, and sweep the curves around from the center of the figure, right and left to the ends of the spirals, taking special care to maintain the gradual convergence of the lines. If the curves, when they appear to be easy and graceful scrolls, vary a little from the guide points, it does not matter. In inking, one half of this figure must be done entirely freehand, the other half as much as possible with the irregular curve.

# CONVENTI

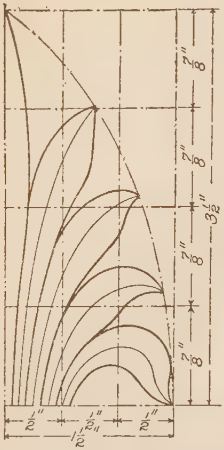

Fig.1.

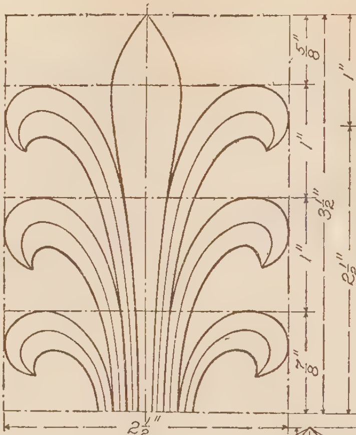

Fig.2.

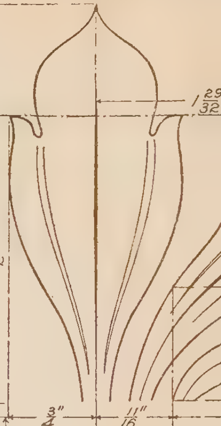

Fig.3.

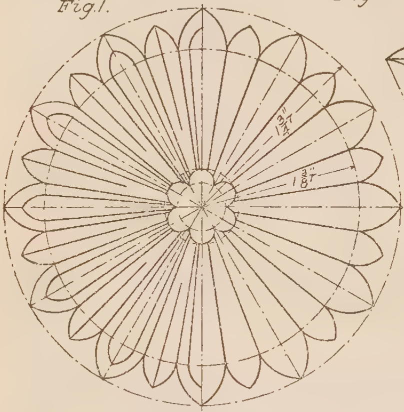

Fig.7.

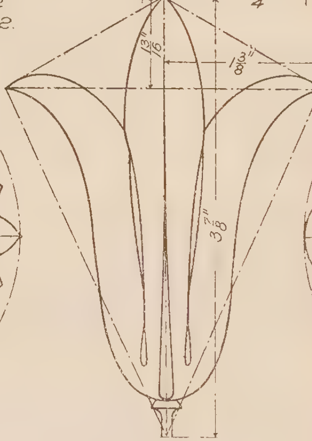

Fig.8.

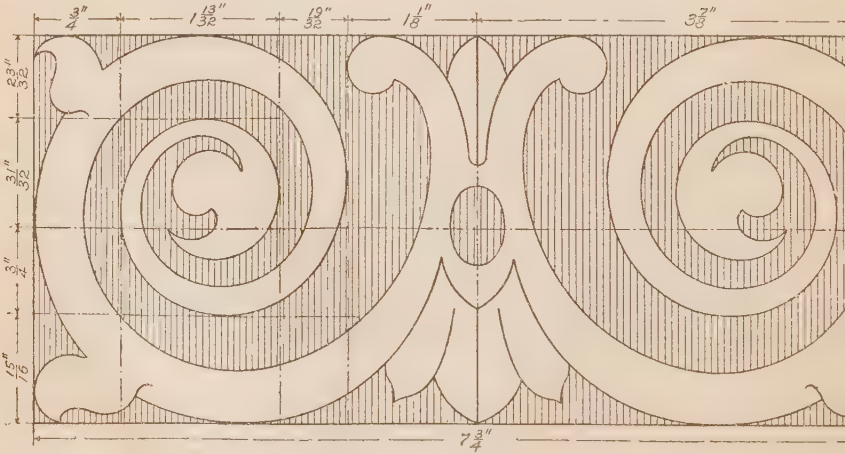

Fig.12

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# LIZED LEAVES.

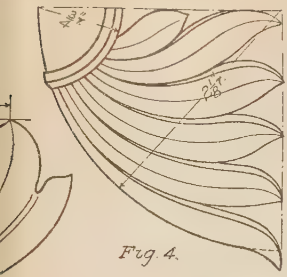


Fig. 4.

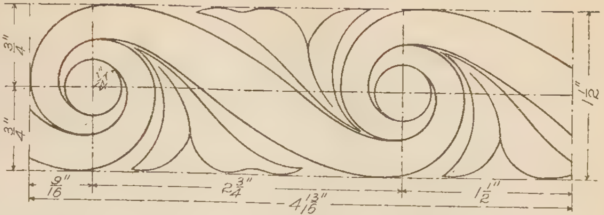
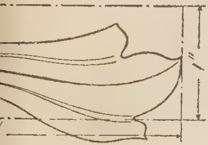


Fig. 5



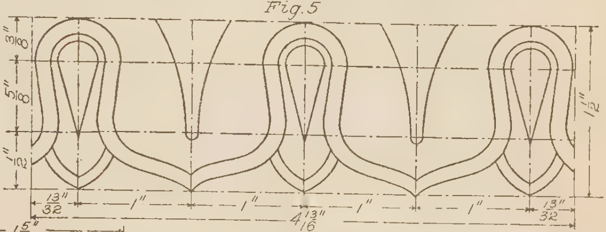
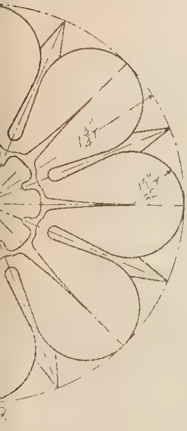


Fig. 6.



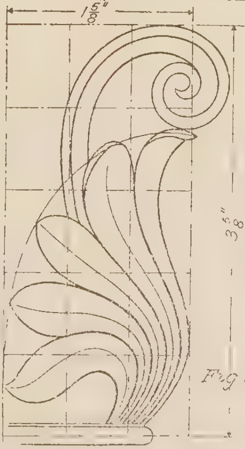


Fig 10

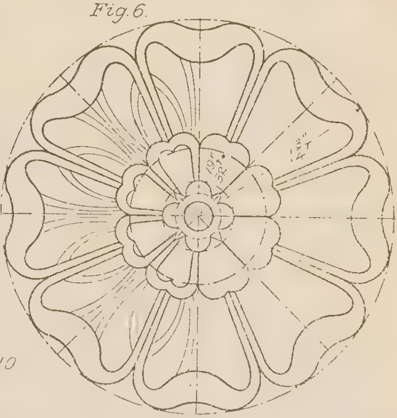


Fig 11.

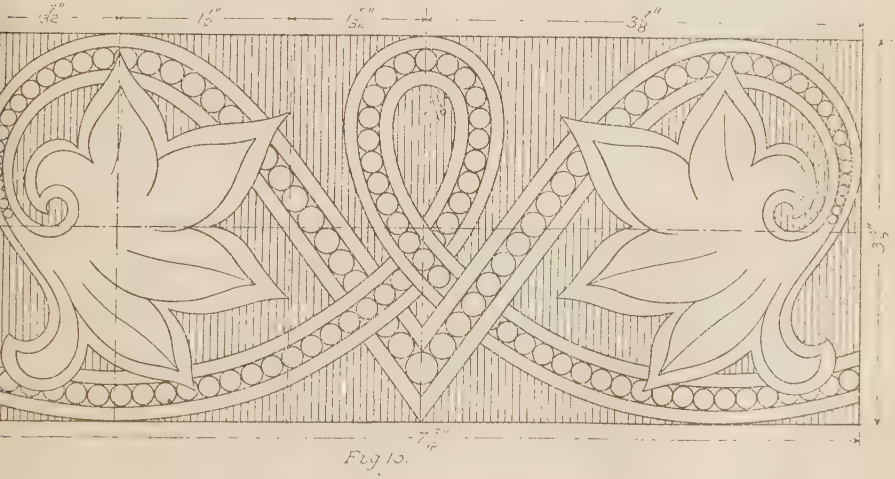


Fig 13.

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Fig. 13 is a **Byzantine ornament,** a combination of freehand and geometrical lines, showing bandwork studded with dewdrops, terminating in a leaf of the peculiar pointed pattern of this style. The difficulties of this exercise are in the long-drawn lower curves joining in the central loop, and in the joint of the straight part of the ribbon with the sharp upper curve towards the leaf. Only a few points of location are, or can be, given for this figure; we wish the student to rely more and more upon his *eye* and upon merely approximate measurements. Proceed as before, inking one half freehand, including the dewdrops, the other half as much as possible with the irregular curve and the bow-pen.

## DRAWING PLATE, TITLE: LEAVES AND FOLIAGE

**13.** In this plate are shown seven figures of more or less conventionalized leaves, and combinations of leaves, flowers, and foliage. It is assumed that by this time the student has acquired a certain amount of dexterity in handling his pencil and freehand pen, and can reproduce, at will, any of the simpler patterns or designs here submitted, without extensive directions as to the proper method of procedure.

In Fig. 1 is shown the conventionalized natural formation of three leaves growing together; the leaves do not possess the curl natural to the growing plant, but may be considered as a front view and two side views of the leaf as it appears in growth. The left side of the figure shows the outline of the general form of the leaf which must first be drawn, and the right side shows the finished leaf with the serrations, or notched edges, drawn in, and the construction lines removed. The length of the figure from *a* to *b* is 4¼ inches, while its breadth from *c* to *d* is 4¾ inches.

Fig. 2 shows a **conventionalized acanthus leaf,** and is an important figure to the student, as in its varied forms it plays an important part in the details of ornamental design. To draw Fig. 2, the central line *a b* is laid out 4¼ inches long, and is divided into four equal parts, at *k*, *l*, and *m*. Through the upper and the lower of these divisions, the lines *e f* and *g h* are drawn, each $2\frac{1}{8}$ inches in length; and through the center the line *c d* is drawn $2\frac{5}{8}$ inches in length. Through the points so located, the curves *a c b* and *a d b* are drawn, within which the details of the leaf are outlined. Where the lobes of the leaf lap over one another, it is the lower lobe that is drawn with the full line, while the upper lobe is dotted under.

Fig. 3 shows a *conventionalized form of leaf* much used in classic designs. In drawing this figure, the center line *a b* is laid out $4\frac{1}{4}$ inches long, and the points *c*, *d*, *e*, and *f* are laid off below *a* 1 inch, $1\frac{3}{4}$ inches, 2 inches, and $2\frac{3}{4}$ inches, respectively. Horizontal lines are then drawn through these points, and the vertical lines *g h* and *j k* are drawn $1\frac{1}{8}$ inches and $1\frac{3}{8}$ inches from the center line *a b*. The curves of the leaf lobes are then drawn in, and the spear-head centerpiece on the line *a b* is drawn last, and proportioned so that its greatest breadth on the line *l m* is $\frac{5}{8}$ inch below the point *a* and $\frac{11}{16}$ inch in width. Additional construction lines may be drawn for the inner curves of the leaf lobes, if desirable, in which case the lines *o q* and *r t* may be drawn $\frac{13}{16}$ inch and $1\frac{1}{16}$ inches from *a b*, and the lines *o p* and *r s* may be $\frac{5}{16}$ inch and $\frac{3}{8}$ inch above the lines *h d* and *k f*. When the figure is inked in, all the construction lines should be erased on the right side of the leaf, while the construction lines on the left side may be dotted with the ruling pen.

Fig. 4 shows a form of **double scroll** that frequently occurs in conventionalized foliage designs. It should be drawn entirely freehand, without any construction lines other than the center line *a b*, which is $4\frac{1}{4}$ inches long.

All these figures are $1\frac{1}{8}$ inches below the upper border line, and their center lines are $3\frac{1}{8}$ inches, $7\frac{1}{2}$ inches, $10\frac{3}{4}$ inches, and $14\frac{1}{2}$ inches to the right of the left-hand border line.

Fig. 5 is a pattern of **foliated border** which occurs very frequently in both carved and painted designs of Greek ornament.

It may be repeated unlimitedly by drawing as much of the design as occurs within the rectangle *a b d c*, and then

# LEAVES

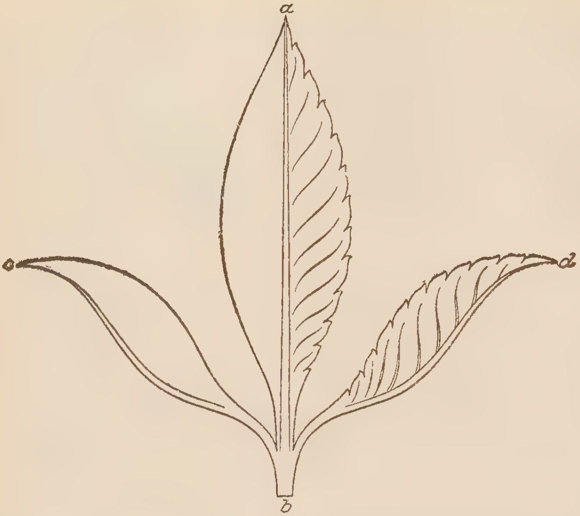


Fig 1

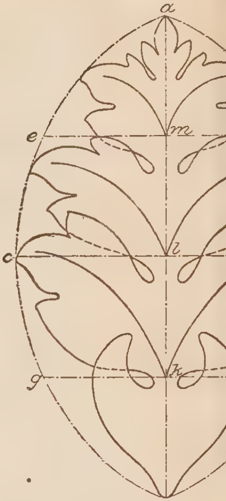
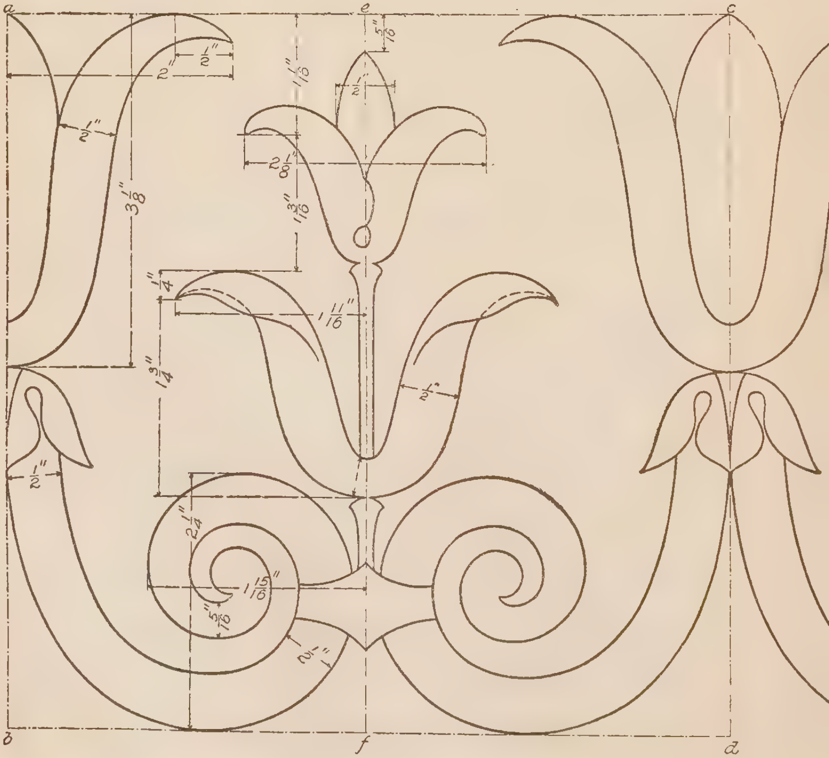


Fig. 2



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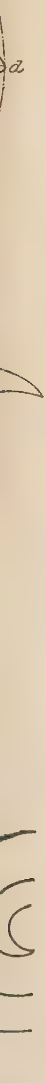
# FOLIAGE.



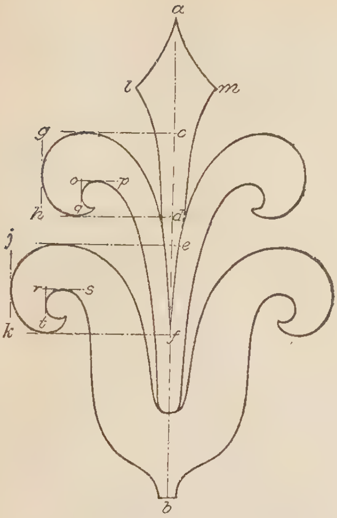


Fig.3.

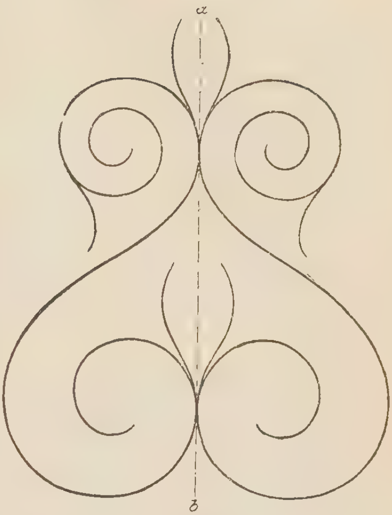


Fig.4.

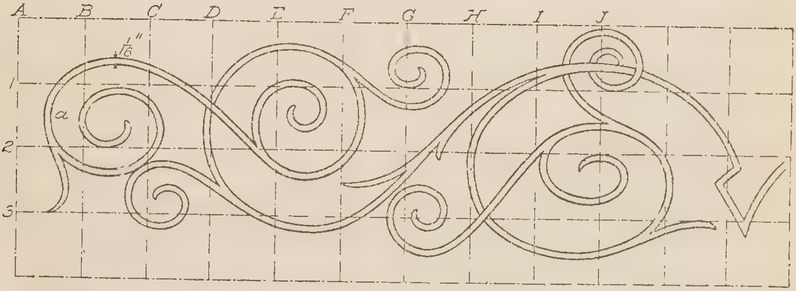


Fig. 6.

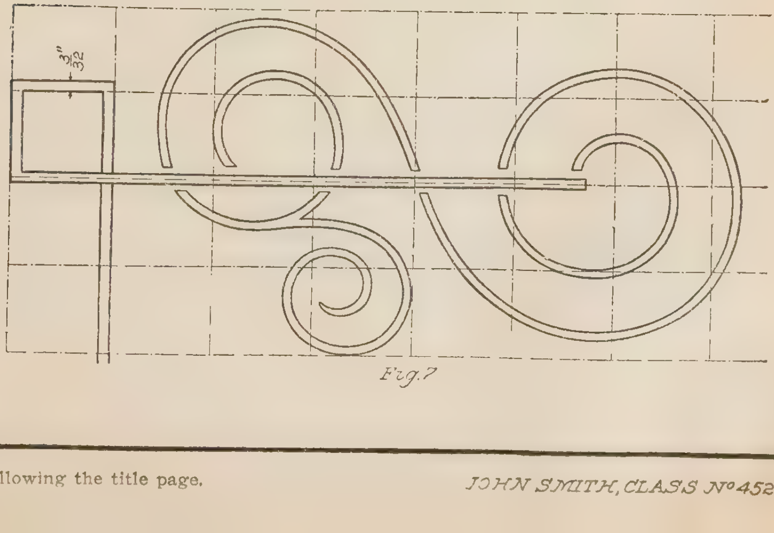


Fig.7

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duplicating the design within a similar rectangle to the right and left. In drawing Fig. 5, the student should first construct a rectangle *a b d c*, $6\frac{3}{8}$ inches long by $6\frac{5}{16}$ inches high, through the center of which a vertical line *e f* is drawn as the center line of the ornament. The design is then carefully drawn in, entirely freehand, only such points being mechanically located as are indicated by the dimensions. When the figure is completed within the rectangle, the right half of the flower may be completed on the right of the line *c d*, and the figure then inked in. The student need not show the dimensions on his drawing.

In Figs. 6 and 7 are shown two **scroll designs**, and also a method of reproducing, with comparative accuracy, any pattern which may be desired. In Fig. 6 a rectangle is drawn $2\frac{1}{4}$ inches high and $6\frac{3}{4}$ inches long, which is divided into 48 squares of $\frac{9}{16}$ inch each. Within this rectangle the pattern is drawn freehand by noting where each line of the design crosses the lines of the squares, and in what direction it crosses the squares themselves. For instance, at *a* it will be seen that the inner curve of the design passes through the center of the square bounded by the lines *1*, *2*, *A*, and *B*, and passes out of the square into the ones above and below, about one-third of the length of the square to the left of the line *B*. It then crosses the line *B* into the square *2*, *3*, *B*, *C*, about one-quarter the length of the side below the line *2*, and leaves this square very close to the intersection of the lines *2* and *C*. In this way the outline of the design may be accurately drawn and inked, after which the construction lines may be erased, leaving the pattern to stand alone.

Fig. 7 may be drawn in precisely the same manner, except that the main outline of the construction encloses a number of rectangles instead of squares, each of which is $\frac{3}{4}$ inch high by $\frac{7}{8}$ inch long, making the exterior rectangle, which bounds the figure, 3 inches high and 7 inches long. In drawing this figure, the student may use his ruling pen in conjunction with the T square and triangle to ink in the straight-line portion, and with his irregular curve to ink the scrolls; but in the latter part of the work he should exercise the same care in joining the ends of the curved lines as in freehand work, leaving small spaces between the abutting ends of two curves, rather than have them lap over one on the other. When the figure is complete and inked, the construction lines should be erased as before.

## DRAWING PLATE, TITLE: GEOMETRICAL ORNAMENT

**14.** All conventionalized ornament used in practical problems of ornamental design is, to a certain extent, geometrical in its formation, inasmuch as it is always conducted on geometrical lines; but the four figures in this plate are more geometrical than the previous ones, as, with the exception of Fig. 1, they are not only duplicated on opposite sides of a center line, but they are also enclosed within the outlines of a fixed geometrical form. Figs. 1 and 3 are bounded by a quadrangular form, Fig. 4 is enclosed within an ellipse, and Fig. 2 is a combination of Fig. 1 with straight and curved lines.

Fig. 1 is what is known as a **volute,** and is a spiral ornament used in carved and painted designs of Grecian or Roman origin. The example here given is purely Greek, and its proportions of height and width are governed by definite geometrical rules for each convolution. In drawing a Grecian volute, the construction lines $a\,b$, $b\,c$, and $c\,d$ should be laid out in the proportion of $6\frac{1}{2} : 5\frac{1}{2} : 4\frac{1}{2}$. That is, if $a\,b$ is $6\frac{1}{2}$ inches long, then $b\,c$ and $c\,d$ must be $5\frac{1}{2}$ inches and $4\frac{1}{2}$ inches, respectively. And the construction lines of the inner convolution must have this same proportion; that is, $e\,f : f\,g : g\,h$ as $6\frac{1}{2} : 5\frac{1}{2} : 4\frac{1}{2}$.

To draw Fig. 1, lay off $a\,b = 6\frac{1}{2}$ inches, $b\,c = 5\frac{1}{2}$ inches, and $c\,d = 4\frac{1}{2}$ inches; $e\,f$ is always $\frac{1}{2}\,a\,b$, and $d\,e$ is $\frac{1}{2}\,(c\,d + e\,f)$; therefore, $e\,f$ is $3\frac{1}{4}$ inches, and $d\,e$ is $\frac{4\frac{1}{2} + 3\frac{1}{4}}{2} = 3\frac{7}{8}$ inches; $d\,e$ is, therefore, laid off $3\frac{7}{8}$ inches, and $e\,f$ $3\frac{1}{4}$ inches; $f\,g$ will be in proportion to $e\,f$ as $6\frac{1}{2} : 5\frac{1}{2}$, or $2\frac{3}{4}$ inches, and $g\,h$

Fig.2

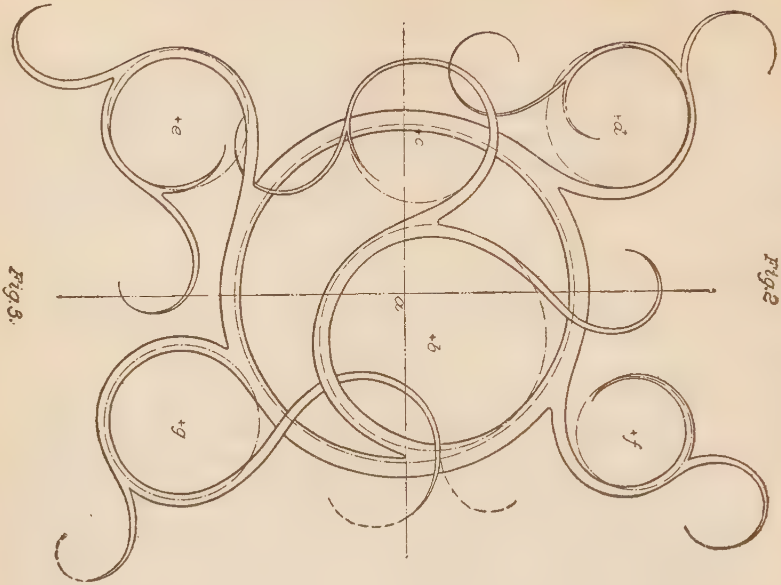


Fig.3.

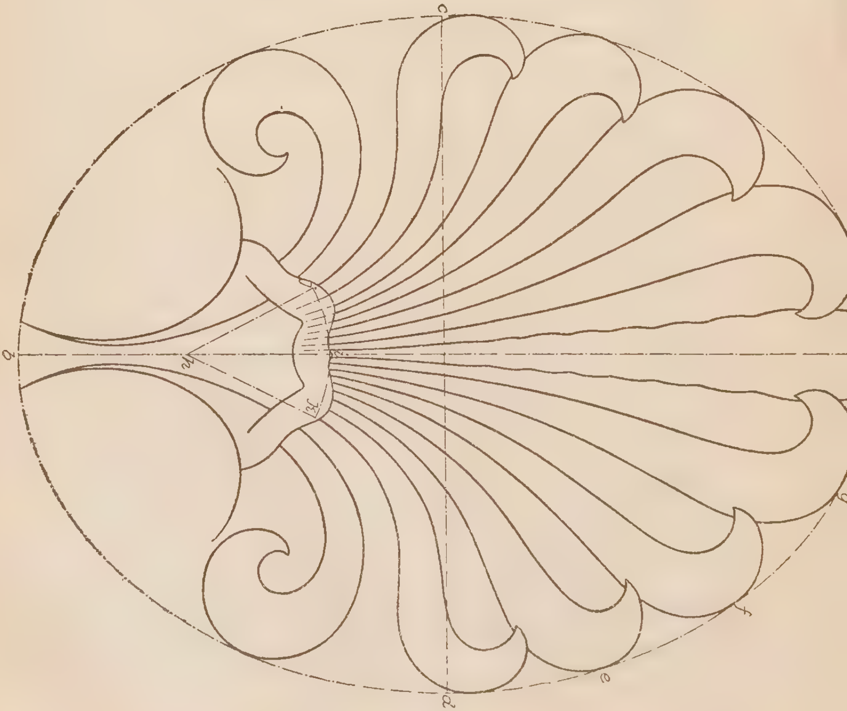
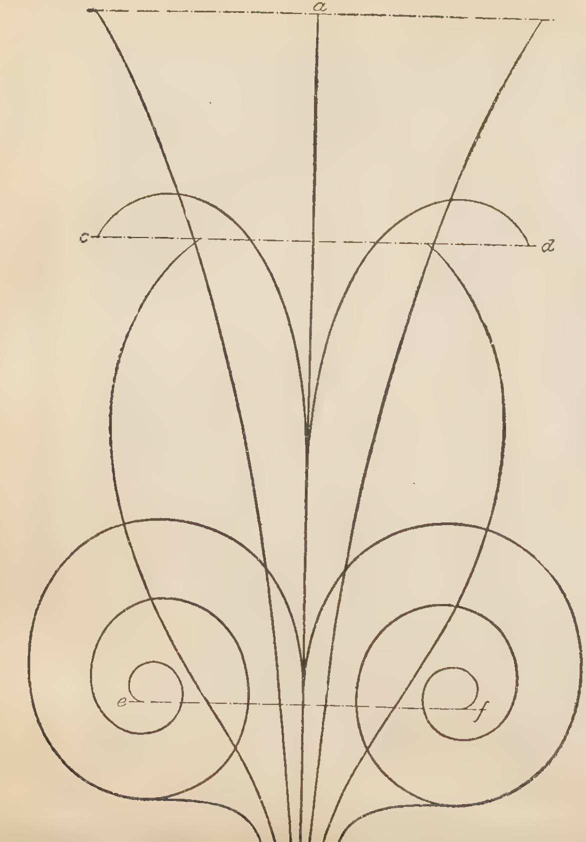


Fig.4.

# GEOMETRICAL ORNAMENT.



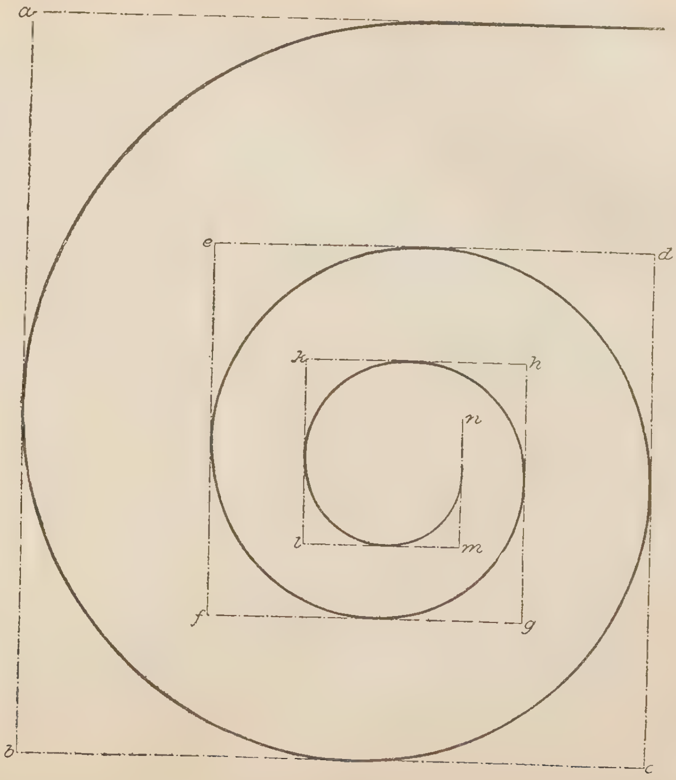


Fig.1.

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will be to $fg$ as $5\frac{1}{2} : 4\frac{1}{2}$, or $2\frac{1}{4}$ inches. In the same manner, $hk$ is found to be $1\frac{15}{16}$ inches, $kl$ is $1\frac{5}{8}$ inches, $lm$ is $1\frac{3}{8}$ inches, and $mn$ is $1\frac{1}{8}$ inches. Within these construction lines the volute is then drawn, care being exercised that the curves are just tangent to the straight lines as they pass. In inking this figure, the student should dot the construction lines with a ruling pen, but the curve must be drawn freehand.

In Fig. 2 we have two volutes similar to that shown in Fig. 1, in conjunction with a number of freehand curves such as were drawn in the first plate. There is nothing new in this figure, and the student can draw the same without any further directions, except that the point $a$ and the lines $cd$ and $ef$ are $\frac{15}{16}$ inch, $2\frac{15}{16}$ inches, and 7 inches below the upper border line, respectively, and the center line $ab$ is $8\frac{1}{4}$ inches long.

Fig. 3 shows an **ornamental form** used largely in wood and stone carving. Its curves are derived almost entirely from the arcs of circles, and the student may lay out the construction lines with a compass, and draw the figure itself freehand. The central circle is 3 inches in diameter, and inside of the circumference a smaller circle 2 inches in diameter is drawn with its center at $b$ $\frac{1}{4}$ inch above and $\frac{3}{8}$ inch to the right of $a$; at $c$ is the center of another circle $1\frac{1}{4}$ inches in diameter, $1\frac{7}{16}$ inches to the left, and $\frac{1}{8}$ inch above $a$. Two more $1\frac{1}{4}$-inch circles have their centers at $d$ and $e$, $1\frac{7}{8}$ inches above, 2 inches below, and $1\frac{5}{8}$ inches to the left of $a$. The center at $f$ is $1\frac{1}{4}$ inches to the right and 2 inches above $a$, and around it is turned a circle 1 inch in diameter, while two inches below $a$ and $1\frac{1}{8}$ inches to the right, the center of a $1\frac{3}{8}$-inch circle is located at $g$. With these circles as construction lines, the student should now proceed to draw the design, sketching the outline roughly at first, to secure the rounding of the curves, and then gradually evening up the lines until it is ready for inking in. Observe attentively that the three principles of foliated ornament are obeyed in the drawing of this figure. See that the main, or parent, stem is the largest, and that the offshoots leave it on a tangent line; also, carefully observe that the construction circles *do not* form the center lines of the tendrils and branches, but simply serve to guide their curvature at the start. Careful study of the place and amount of the departure from the circular construction lines will enable the student to draw, with considerable accuracy, those branches and tendrils for which no construction has been provided. When the figure is inked, the construction lines may be dotted in place with the bow-pen.

Fig. 4 shows a Greek ornament called a **palmette.** It is an extremely conventionalized form of the Egyptian lotus flower, and is an important detail in architectural ornament. To draw the figure, an ellipse is first constructed $7\frac{1}{2}$ inches long and 6 inches wide, through the longitudinal axis of which is drawn a line $a\,b$, and through the transverse axis the line $c\,d$. From $d$ the distances $d\,e$, $e\,f$, and $f\,g$ are laid off, each equal to $1\frac{3}{8}$ inches, and, at the points so located, the exterior curves of the leaves are permitted to become tangent. From a point $h$ coincident with one of the foci of the ellipse, the arc $j\,k$ is drawn with a radius of $1\frac{1}{4}$ inches; and from $i$, the intersection of this arc with the line $a\,b$, the distances $i\,j$ and $i\,k$ are laid off each equal to $\frac{9}{16}$ inch. From $h$ to $j$ and $k$, lines are then drawn, tangent to which the curves of the lower leaves $j\,c$ and $k\,d$ are started. All the curves of the leafwork are then brought down to the arc $j\,k$, as shown, and each curve is tangent to a line convergent to $h$. The other details of the figure are drawn as in the previous examples—by eye measurement.

The student should practice the exercises on this plate repeatedly, and his skill with the pencil, acquired through these examples, will be severely taxed in the work to come.

## DRAWING PLATE, TITLE: APPLIED ORNAMENT

**15.** In this plate are seven figures, each of which is to be drawn according to the system of squares explained in connection with the Drawing Plate, title: Leaves and Foliage, but the squares are larger in proportion to the detail,

# APPLIED

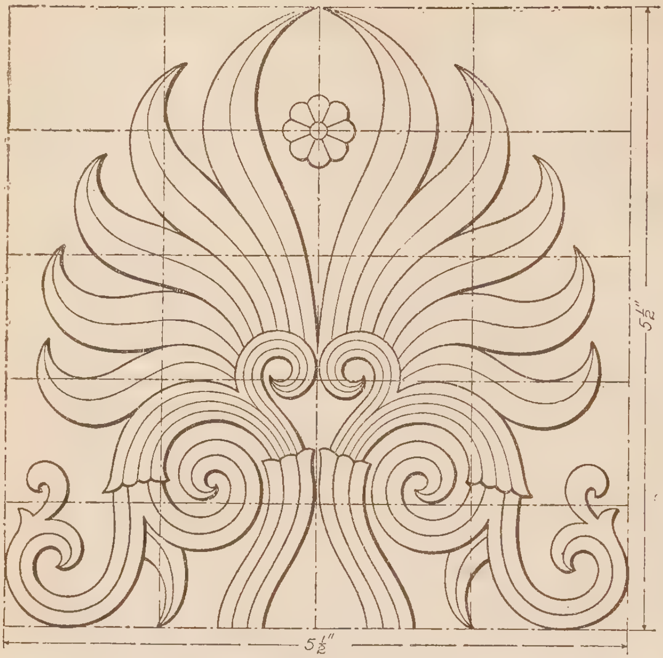
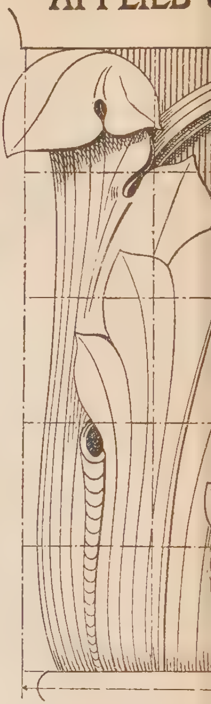


Fig. 1



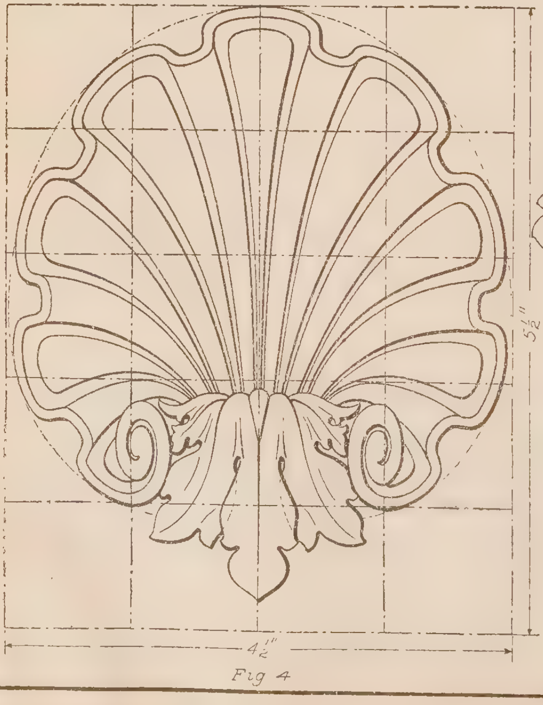
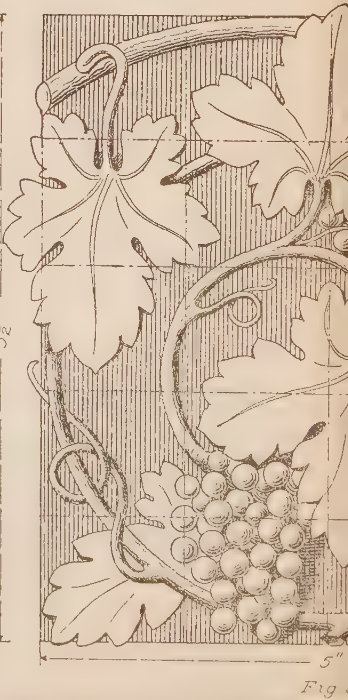


Fig 4



Fig

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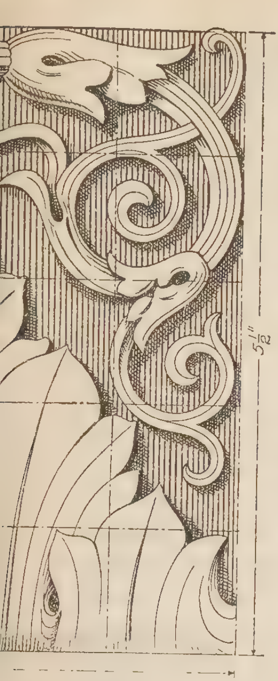


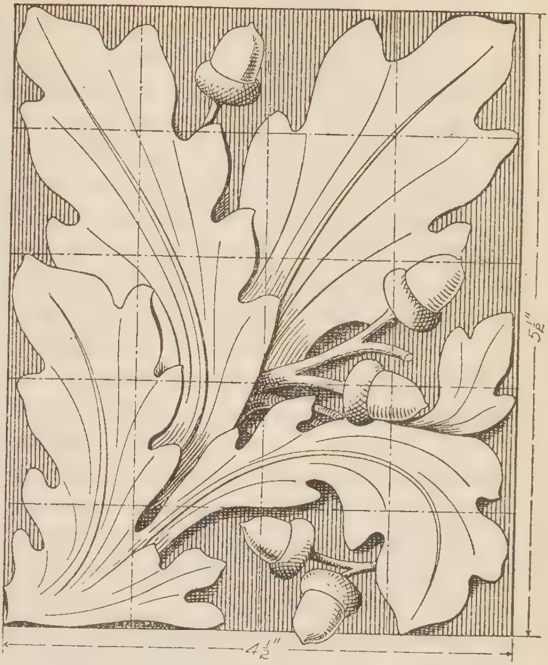
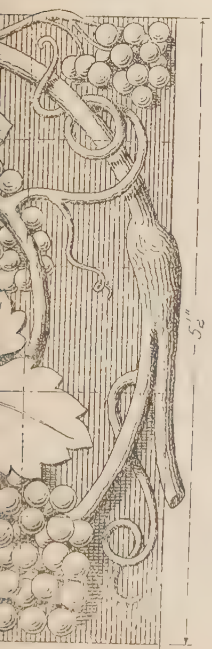


Fig. 3



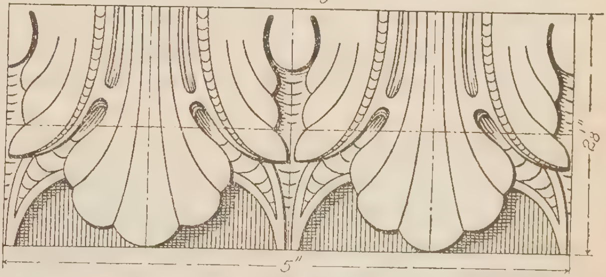


Fig. 6.

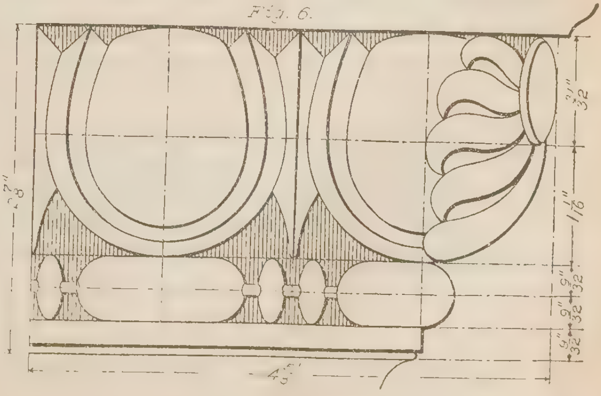


Fig 7

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and the utmost care is required in order to execute the designs with accuracy. In the seven figures of this plate are involved all the problems of straight and curved lines set forth in the five previous plates, and, if the student has diligently practiced on his past work, there is nothing here that will cause him the slightest difficulty. If, on the other hand, the previous work has not been diligently studied, it will be almost impossible for the student to turn out a satisfactory drawing of these figures, and he is advised to review his old work and practice on such details as the instructors have called to his attention, on the previous plates.

Fig. 1 represents a **Grecian palmette,** somewhat similar to Fig. 4 of the previous plate, though the design is based upon a different character of plant.

These ornaments are characteristic details of Grecian architecture, and were used to decorate the head tiles of the eaves of the Grecian temples, and as a termination for the "stele" or slab-like tombstone which they erected over their graves. Palmettes occur in a less monumental way, in almost every field of ornamentation, and, while always adhering to their original simplicity of form, they show much variety and great beauty of design. The palmette of our example is distinguished by the sweeping double curvature of the leaves, and is taken from the stele of the best Athenian period.

As to the scrollwork of this ornament and also of the following one, the richly reeded stems and the grooved modeling of the runners are typical of Grecian ornamentation in its clean-cut, strong, and simple lines. The vegetable prototypes of this style of work are to be found in the hollow-stemmed reedy grasses of the fields, in the bulrushes of the swamps, and in the lower orders of such vines as the pumpkin and melon.

To draw Fig. 1, lay out the guide lines as marked, dividing the panel into five horizontal and four vertical equal strips; locate the tips of the leaves and principal points of the scrolls. The inking must be done entirely freehand.

Fig. 2 represents the conventional **Roman acanthus leaf.**

In this form it is used to ornament the corner of a frieze or capital, and shows the top lobe of the leaf lapping over, which is a characteristic point of the conventional acanthus.

No other vegetable element of ornamentation has been so extensively employed as the acanthus leaf and flower; it occurs in every phase of ancient and modern classical art, as well as in the Byzantine and Romanesque styles. It therefore follows that there are a great many distinct methods of treating this leaf in shape and modulation, which will be discussed in the section on *Architectural Design*. To draw Fig. 2, proceed as before; mark well the shape of the lobes and their loop-like overlapping of one another; also, the cut of the separate tips, and ink the exercise freehand.

Fig. 3 is a sprig of **oak leaves** and **acorns** without direct application to any special ornament, and Fig. 5 shows the **grape vine** in the same general way. Both examples may be regarded as detached parts of an arabesque. The use of the oak leaf and vine was limited and more symbolical than ornamental in classic architecture; but in the arabesques of the Italian style and in modern classical compositions, the leaf of the sturdy oak and the tendrils of the running vine occur more frequently, and often side by side in the same ornament. It is, however, in the Gothic style that the oak and vine, with the lily and the ivy, find their true sphere of ornamental employment, since these forms lend themselves especially well for naturalistic treatment.

In drawing Figs. 3 and 5, the student will proceed as with previous examples; avoid the small details at first, and draw the compositions in their general lines and movement before attempting the minor accessories. Although apparently intricate, the student will find these exercises less difficult than the strictly symmetrical leafwork and the clean-cut shapes and scrolls of some preceding examples.

Fig. 4 represents a shell ornament, generally designated by the French name **cartouche.** Although appearing in a limited way in Roman and Italian architecture, this class of ornament can be called specifically French, from the extensive employment and magnificent development it received in French styles of decoration. It is used much like the palmette, as a crowning ornament or as an important feature of arabesques, or the running ornamentation of friezes. In inking this figure, the lines of the ribs may be put in with the curve.

Fig. 6 is a Roman example of rich *molding decoration* of the water-leaf pattern, and Fig. 7 is what is known as the egg-and-dart ornament often carved on classic moldings. These figures may be drawn and inked on the construction lines, as shown.

**16. Conclusion.**—Though the exercises in this branch of the course of study end herewith, additional practice in ornamental drawing, and information about ornament, is furnished in the section on *Advanced Architectural Drawing*. The subject will be still more fully discussed in the sections treating on the architectural styles and the principles of design.

This subject brings the student to that part of his course which is purely architectural. He should now be able to reproduce any ornamental form he desires, and should constantly practice the sketching of natural objects, such as leaves, flowers, trees, feathers, etc., rendering them at first in their most natural form, and reducing them subsequently to conventionalized lines, where the construction is geometrical and systematic, but where the distinguishing characteristics of the original object are fully portrayed.

To make this more clear, take, for example, the oak leaf. A sketch of this object will show a long, somewhat oval leaf, with deep rounded indentations, and rounded lobes. When a conventionalized oak leaf is drawn, these characteristics must be preserved. The enclosing construction lines may be elliptical, and the indentations must be deep and round, though the halves of the figure are duplicated on the opposite side of a center line. In the same way the pointed lobes of the maple leaf, and the trumpet shape of the morning glory, must be retained in the conventionalized design, as distinguishing characteristics of the original type.

# ADVANCED ARCHITECTURAL DRAWING

## INTRODUCTION

**1.** In *Architectural Drawing*, the examples treated in the plates could be executed entirely with the instruments, and consisted of such plans and details as constitute the larger part of architectural office practice.

The subjects treated in this section will consist of architectural features that will involve both freehand and instrumental drawing, giving the student an opportunity of exhibiting the progress he has made in ornamental drawing, and imparting to him a knowledge of the application of ornament in architectural design.

The plates to be drawn from this paper are to be the same size as those of the previous ones, viz., 13 in. × 17 in. inside the border lines. No part of a drawing should be inked in before the whole drawing has been finished in pencil, as was explained in detail in *Geometrical Drawing;* and all the dimensions and dimension lines, as well as the shade lines and headings, should be shown, but the reference letters may be omitted entirely.

## THE ORDER

**2.** An **order** in architecture is the term applied to the system used by the architects of the classic period to proportion the various parts and details of their buildings. There are five of these orders—the Tuscan, Doric, Ionic, Corinthian, and Composite—each of which possesses distinguishing

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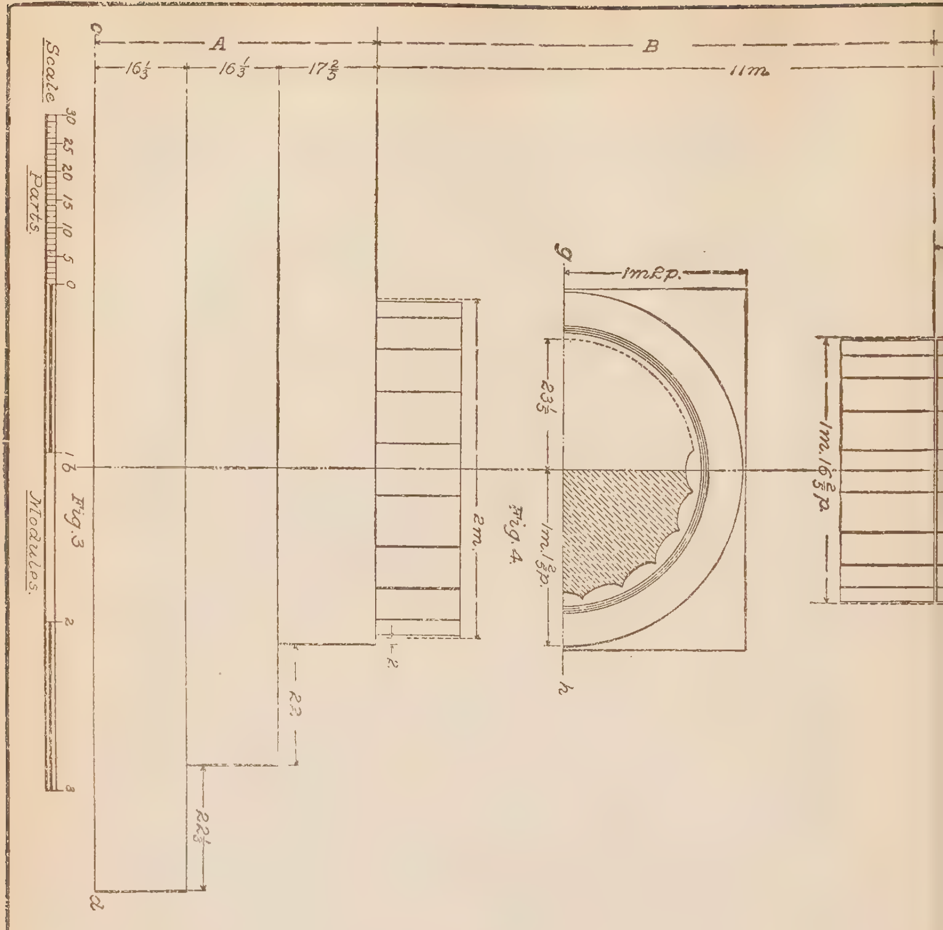
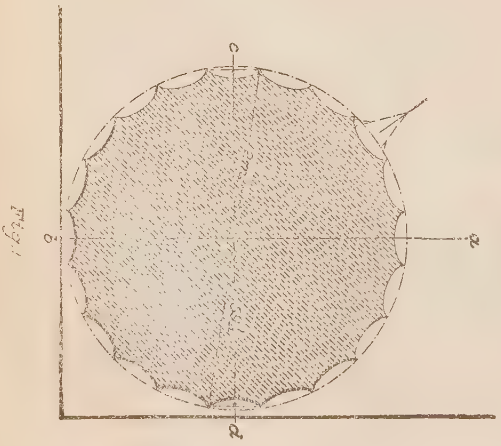
characteristics of form and proportion, which will be pointed out in the explanation of the following plates, while the complete analysis of the orders and their details will be discussed in *Architectural History and Design*.

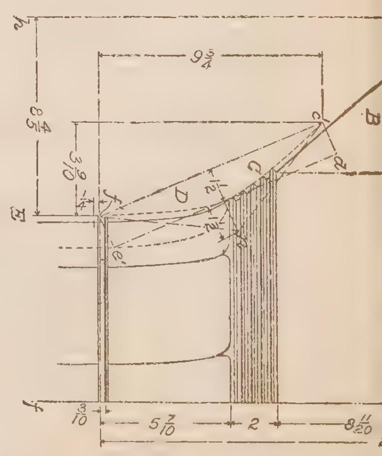
The Doric, Ionic, and Corinthian orders were originated by the Greeks, and the first three of the following eight plates will exhibit the orders in their early Greek form. The next five plates will show the Roman modification of these orders, together with two additional orders, which are of purely Roman invention, namely, the Tuscan and the Composite. These five orders, or systems of proportion, are of the utmost importance to the student, as they furnish him with a set of rules by which he may determine the relations that should exist between certain parts and details of a building. These rules are subject to slight variations in modern works, but are positive so far as their applications to the original orders are concerned.

All the orders consist essentially of three principal divisions; namely, the **stylobate,** the **column,** and the **entablature.** The stylobate is that portion of an order which forms the substructure, or foundation on which the column or columns stand, and is usually disposed so as to distribute the load transmitted by the column over a larger area than is represented by the section of the column itself. The column consists of the shaft or pier which supports the superstructure, and is usually possessed of an ornamental **base** and **capital,** which are details that differ widely in the several orders, as will be explained as they are met with in the following exercises. The entablature is the superstructure proper. It consists of three principal divisions, called the **architrave, frieze,** and **cornice,** each of which serves a particular purpose, both structural and ornamental, as explained further on.

As the three Greek orders were the original systems, the student will first make drawings of them, and it is suggested that he pay particular attention to the explanations given in the text, so that the drawing of the subsequent Roman orders and their details may be fully understood.







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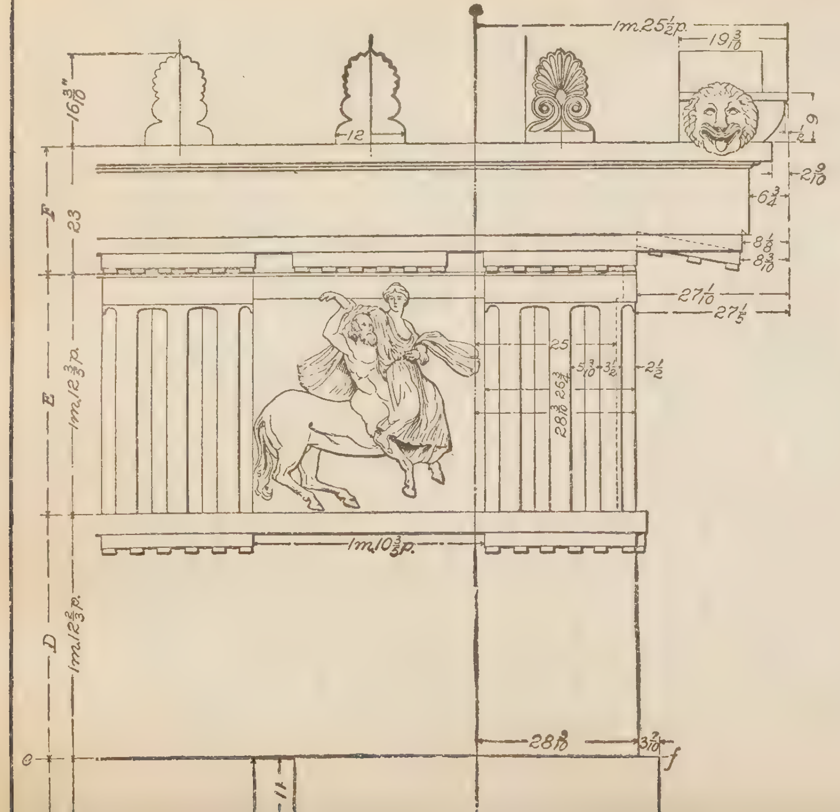
# GRECIAN DORIC.



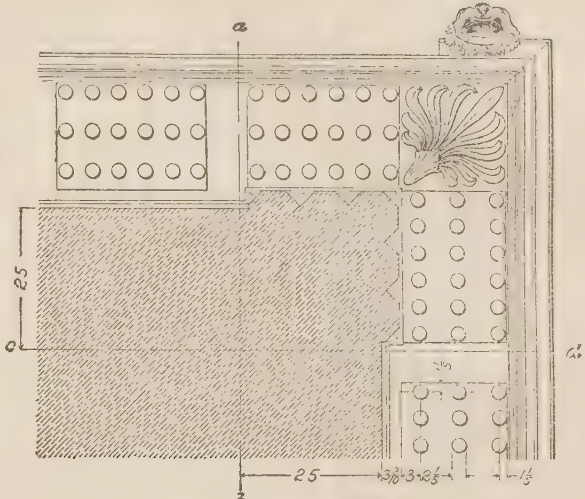
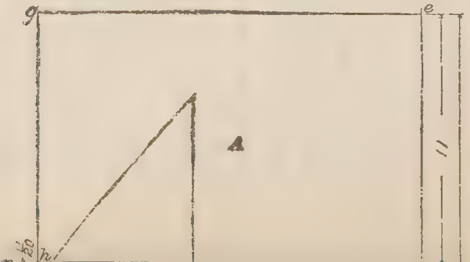


Fig. 5.



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## DRAWING PLATE, TITLE: GRECIAN DORIC

**3.** The Doric is the most ancient of the three Grecian orders, and represents the system of columnar construction in its simpler form. In Fig. 3 of this plate, *A* shows the stylobate of the order disposed in three equal steps, so as to spread the foundation area of the structure. *B* is the shaft of the column, and *C* is the capital. (The Grecian-Doric column has no base.) *D* is the architrave, which consisted in the early Greek structures of a number of lintels or stone beams, extending from the top of one column to the top of the next. *E* is the frieze, which was occupied by a number of stone ceiling beams or flat slabs, which rested their ends on the lintels of the architraves and formed the direct ceiling on the inside of the structure. *F*, the cornice, was the roof construction proper, and consisted of stone details built above the frieze to cover the ends of the roof beams and to provide a suitable finish to the eaves. The general effect of these details, when assembled in the complete order, is shown in the perspective sketch, Fig. 1, of the text.

The column of the order shown in this plate is 24 inches in diameter, and is drawn to a scale of 1½ inches = 1 foot, as are all of the following plates of the orders; but the 1½-inch scale is not used to proportion the various details, as the diameter of the column is the governing measurement, and in architectural orders the members are proportioned in their ratio to the diameter of the column, according to an arbitrary scale of **modules** and **parts,** as explained further on.

The term *module* is a diminutive of the Latin *modus*, meaning "a measure"; and in the architectural orders the module is in nearly all cases equal to one-half of the diameter of the column. The diameter of the column in this plate being 24 inches, the module is 12 inches. The module is divided into 30 subdivisions, called *parts*, and a dimension of 2 modules and 15 parts would, on this plate, be equivalent to 2 feet 6 inches. In the following descriptions of the orders, the terms "modules" and "parts" will be abbreviated to "m." and "p.," in order that the text may correspond

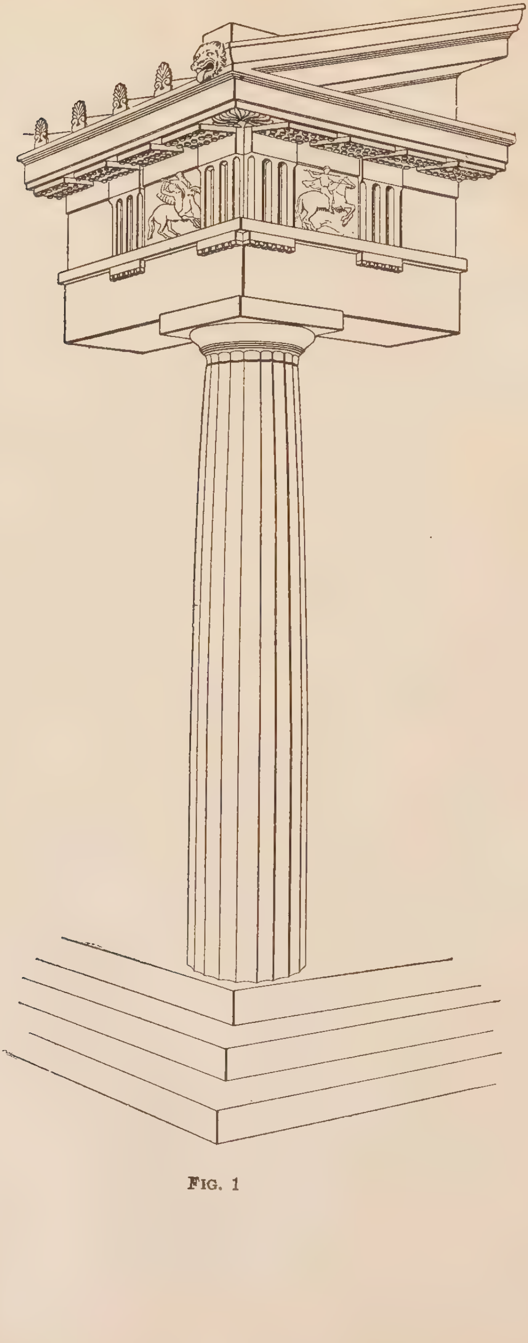


FIG. 1

more closely with the expressed measurements on the drawing plate, and that there may be no confusion with regard to the word "parts" when it is used in a more general sense. Begin this plate by constructing a scale of modules as shown. Draw a line 6 inches in length and $\frac{3}{8}$ inch above the lower border line. Divide this line into 4 equal parts of 1 m. each, and subdivide the first part into 30 p., as shown. Now draw Fig. 1, which is a plan of the column and stylobate; locate the lines of the upper step, each $\frac{3}{4}$ inch from, and parallel to, the border lines; draw *a b* and *c d*, the axial lines of the plan of the column, each at a distance of 1 m. 2 p. from the lines of the upper step of the stylobate, and on their point of intersection as a center, and with a radius of 1 m., draw a circle defining the circumference of the shaft. The surface of the shaft is grooved perpendicularly by the 20 flutes, or channels, each of which is cut to an elliptical curve, as shown in the plan. The plan of the column must therefore be divided into 20 equal parts, by lines radiating from its center. Each pair of these lines will embrace $\frac{1}{20}$ of the circumference of the circle defining the plan of the column, or 18°, and the lines will pass through the **arrises,** or sharp edges projecting between the flutes.

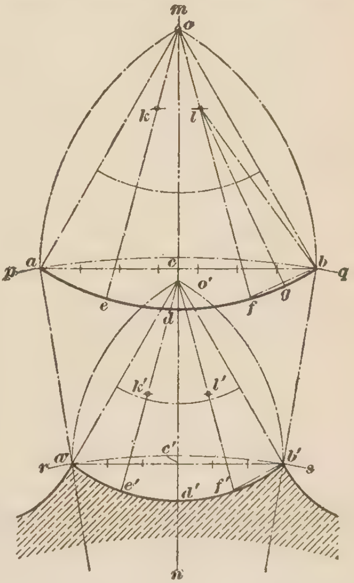


FIG. 2

Before drawing these elliptical flutes in the plan of the column, the student should draw, on a separate piece of paper, Fig. 2 in the text, which is an enlarged plan of one of the flutes, showing the method of striking its curve. At *a d b* of Fig. 2 is shown the form of the channel at the bottom of the shaft; and at *a′ d′ b′*, the form of the same channel at the necking. Let *p q* and *r s* be the arcs of the lower and upper sections of the shaft, respectively, and lay off accurately *a b* and *a′ b′* equal to $\frac{1}{20}$ of the circumference. Draw the chords *a b* and *a′ b′* and the center line *m n*, cutting the chords *a b* and *a′ b′* at *c* and *c′*. For the depth *c d* of the channel at the base, divide *a b* into 7 equal parts, and make *c d* equal to one of these parts; for the depth *c′ d′* at the necking, divide *a′ b′* into 6 equal parts, and make *c′ d′* equal to one of these parts. The depth of the channel at the necking is therefore greater, in proportion to its width, than at the bottom of the shaft. To find the centers of the three arcs that compose the curve *a d b*, construct, upon *a b* as a base, the equilateral triangle *a o b*, and bisect the angles *a o d* and *d o b* by the lines *o e* and *o f*. The point *o* will then be the center of the arc *e d f*. Join *f b*, and at its middle point *g* erect a perpendicular *g l*, cutting *o f* at *l*; the point *l* is the center for the arc *f g b*; the center *k* of the arc *a e* is similarly found. The centers *o′*, *k′*, *l′* for the arc *a′ d′ b′* are determined in precisely the same manner as described for the arc *a d b*.

Now draw Fig. 3, locating the center line *a b* $4\frac{1}{8}$ inches from, and parallel to, the left-hand border line; and at right angles to *a b* draw *c d*, the bottom line of the stylobate, $\frac{3}{4}$ inch above the lower border line; then lay off from *c d*, on *a b*, the measurements of the principal divisions of the order, and draw horizontal lines defining these divisions. Lay off each side of *a b*, on the top step of the stylobate, 1 m., and dot the perpendicular lines defining the extreme diameter of the column, as shown. On the lower line of the architrave *D*, lay off each side of *a b* 32 p., and draw perpendicular lines down from the bottom of the architrave, till they intersect with a horizontal line drawn 11 p. below. These will define the elevation of the **abacus,** or square block on the top of the capital of the column. The diameter of the column is less at the top than at the bottom, and the sides of the column are curved in profile from the base to the neck of the capital; but, as the full length of the column is not shown, the method of profiling this curved outline will not be described at present. When the drawing of the Roman orders is explained, this curved outline of the shaft will be discussed, and the method of describing it will be shown in detail. Draw the outside, or return, lines of the architrave and frieze $28\frac{3}{10}$ p. to the right of the center line *a b*. Then, $26\frac{3}{4}$ p. from the return line of the frieze, draw the perpendicular line defining the width of the **triglyph,** which is the ornamental block set in the frieze over each column and over each space between the columns. The triglyphs, in the early construction, consisted of the ends of the ceiling beams which rested on the architrave. Draw this triglyph at the extremity of the frieze according to the measurements given, and duplicate it as shown, 1 m. $10\frac{3}{4}$ p. to the left. The space between two triglyphs is called a **metope,** and in nearly all examples of Greek architecture the metopes are filled with a carved slab. Immediately over the triglyphs and metopes are the **mutules,** with six little drops, or **guttæ,** as they are called, on the under side. The mutules are not level on the soffit, but pitch upwards, as seen on the return of the cornice, where the mutule is shown in side elevation. These mutules represent the under side of the slanting roof beams as they existed in the early wood construction, and the guttæ are derived from the wooden treenails, or pins, which held these members in place. Draw the **corona,** which is the broad band of the cornice, and above it draw the molding, and also the palmettes which are centered over each mutule. Draw the lion head and echinus at the return line, carefully following the measurements given on the drawing plate.

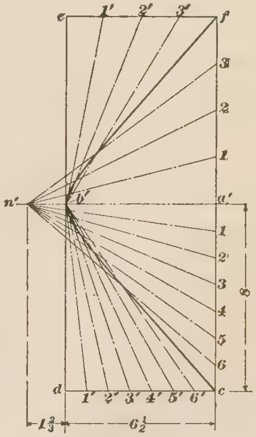


FIG. 3

Now draw Fig. 2, which is an elevation of the details of the capital, four times the scale of Fig. 3. Draw *e f* in line with the right-hand side of the stybolate in Fig. 1, and locate *g e*, the upper line of the abacus, $11\frac{1}{4}$ inches above the lower border line. Draw the abacus 11 p. deep. Before profiling the echinus *B* and the curve of the shaft at *D*, both of which are arcs of hyperbolas, the student should give his attention to Fig. 3 in the text, which is a method of describing a hyperbolic curve.

Lay off $a' b'$ 6 p. long, and upon $a' b'$ as an axis, construct the rectangle *c d e f*, marking off $a' c$ 8 p. long. Produce $a' b'$ to $n'$, making $b' n'$ $1\frac{2}{3}$ p. long. Divide $a' c$ and $a' f$ into any convenient number of equal parts, as at *1*, *2*, *3*, etc., and divide *c d* and *f e* into the same number of equal parts, as at $1'$, $2'$, $3'$, etc. Join $n'$ *1* and $b' 1'$, and their intersection will be a point of the required curve. Other points in the curve of the hyperbola are similarly found, by drawing the intersecting lines $n' 2$, $b' 2'$; $n' 3$, $b' 3'$, etc.

To draw the curve at *C D*, Fig. 2, construct the rectangle $c' d' e' f'$ in its oblique position, according to the measurements given, and inscribe the hyperbola according to the method above described.

The dotted line of this second curve shows the profile of the curve of the neck before the cutting of the channels; or, what is the same thing, the dotted line *C D*, with its downward continuation *E*, gives the true profile of the shaft on an axis passing through two opposite arrises, or edges, between the channels. The straight portion of this line at *E* shows, therefore, the extreme size of the shaft at the necking, and from it the various projections are figured.

As may be seen, part of the hyperbola last drawn determines the projection of the outer faces of the **annulets,** or rings, around the neck of the capital at *C*. These annulets should project about $\frac{1}{4}$ p. from the surface of the echinus; hence this projection, or the distance between the two hyperbolic curves at *C*, will form a check upon the accuracy of the drawing.

The full-line profile, just within the dotted line *c d e*, is the projection of the edges, or arrises, of the channel whose center is upon the axis *c d* of Fig. 1, parallel to the face of the abacus.

The distance between the real and projected profile lines just considered is represented, in Fig. 2 of the text, by the distance between the *arc a′ b′* and the *chord a′ c′ b′*. The inner dotted line, passing near the point *e* on Fig. 2 of drawing plate, gives the depth of the channel at its center; this depth is likewise represented, in Fig. 2 of text, by the distance *c′ d′*.

Now complete the capital of the column in Fig. 3, drawing the echinus according to the method described for Fig. 2; then draw Fig. 4, which is a half plan of the under side of the capital. Locate the center line *g h* 4⅞ inches above the lower border line; draw the flutes as shown, describing their curves from centers found according to the methods explained for Fig. 2 in the text. Project the lines of these flutes to the upper part of the column in Fig. 3, and project the lines of the flutes in Fig. 1 to the center line *c d*, from which their spacing may be marked on a strip of paper and transferred to the lower part of the column in Fig. 3. Now finish Fig. 3 entirely, and commence Fig. 5, which is a section through the frieze looking upwards, showing the soffit of the corona; draw the axial lines *a b* and *c d* 3½ inches and 4 inches, respectively, from the border lines; mark points locating, and draw lines defining, the various members of the corona, according to the measurements given in Fig. 3; then locate and draw the triglyphs and guttæ, and draw the anthemion ornament and lion head freehand.

## DRAWING PLATE, TITLE: GRECIAN IONIC

**4.** In this plate, showing the details of the Grecian-Ionic order, the stylobate is shown at *A*; the base, shaft, and capital of the column at *B*, *C*, and *D*, respectively; and the architrave, frieze, and cornice of the entablature at *E*, *F*, and *G*. A perspective view of the order is shown in Fig. 4 of the text.

The scale to which this plate is to be drawn is the same as for the previous plate, viz., 1½ inches = 1 foot, but the column being but 22½ inches in diameter, the module will be only 11¼ inches. Construct a scale of modules on a line ⅜ inch above, and parallel to, the lower border line, making it 4 m. in length, and dividing the first module into 30 p., as was done on the previous plate. Now draw the center line *a b* at a distance of $4\frac{3}{16}$ inches from, and parallel to, the left-hand border line, and draw the lower line of the stylobate *c d*, $\frac{3}{4}$ inch above the lower border and at right angles to the line *a b*; draw *e f*, the bed line of the architrave, $9\frac{3}{8}$ inches above the lower border line.

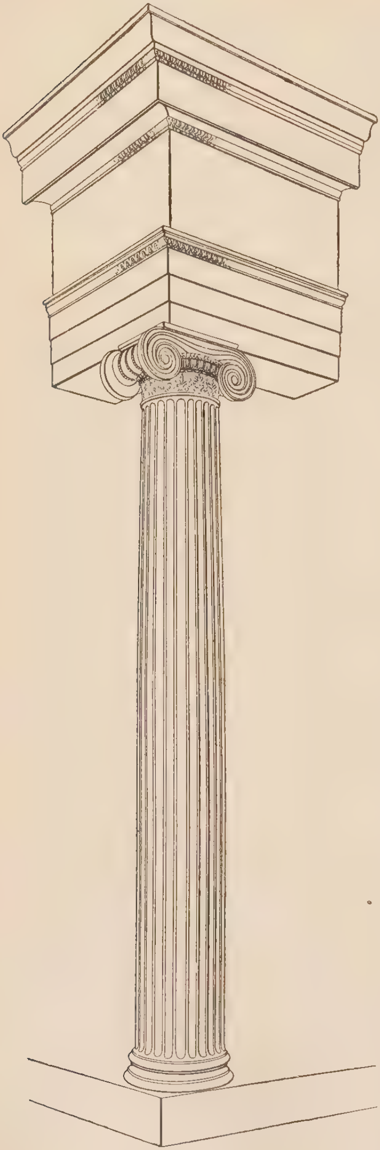
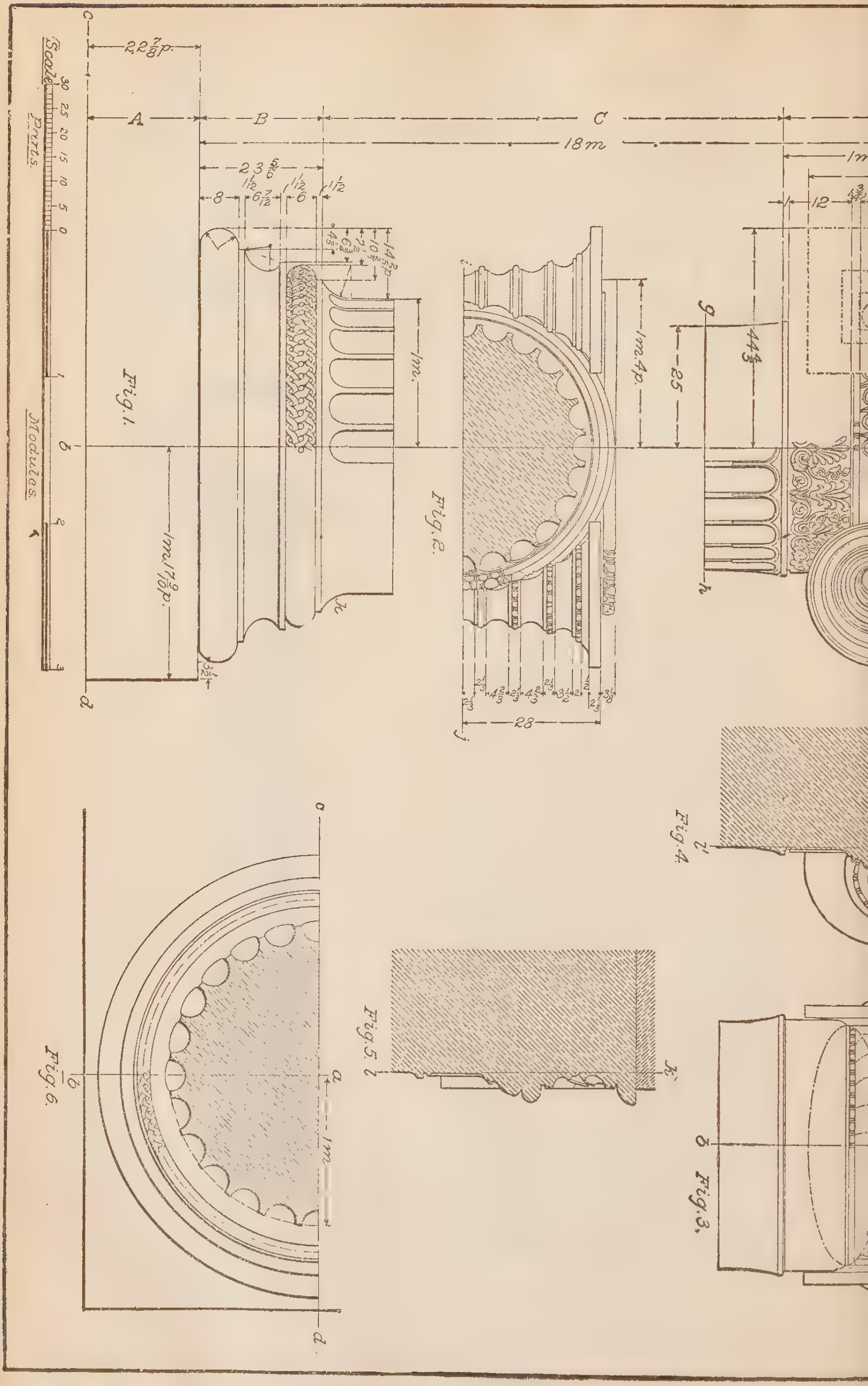


FIG. 4

On the center line *a b* lay off a number of points from the measurements given, locating the position of the horizontal lines of the base, capital, and entablature; locate the centers of the arcs, and profile the moldings of the base, omitting for the present the fluting of the shaft, though the sides and *apophyge* may be shown. **Apophyge** is the term given to the curved expansion from the side of the column where it joins the base, as shown at *k*. Now proceed with the entablature, drawing the three facias of the architrave and the moldings crowning them—carefully profiling these moldings according to the



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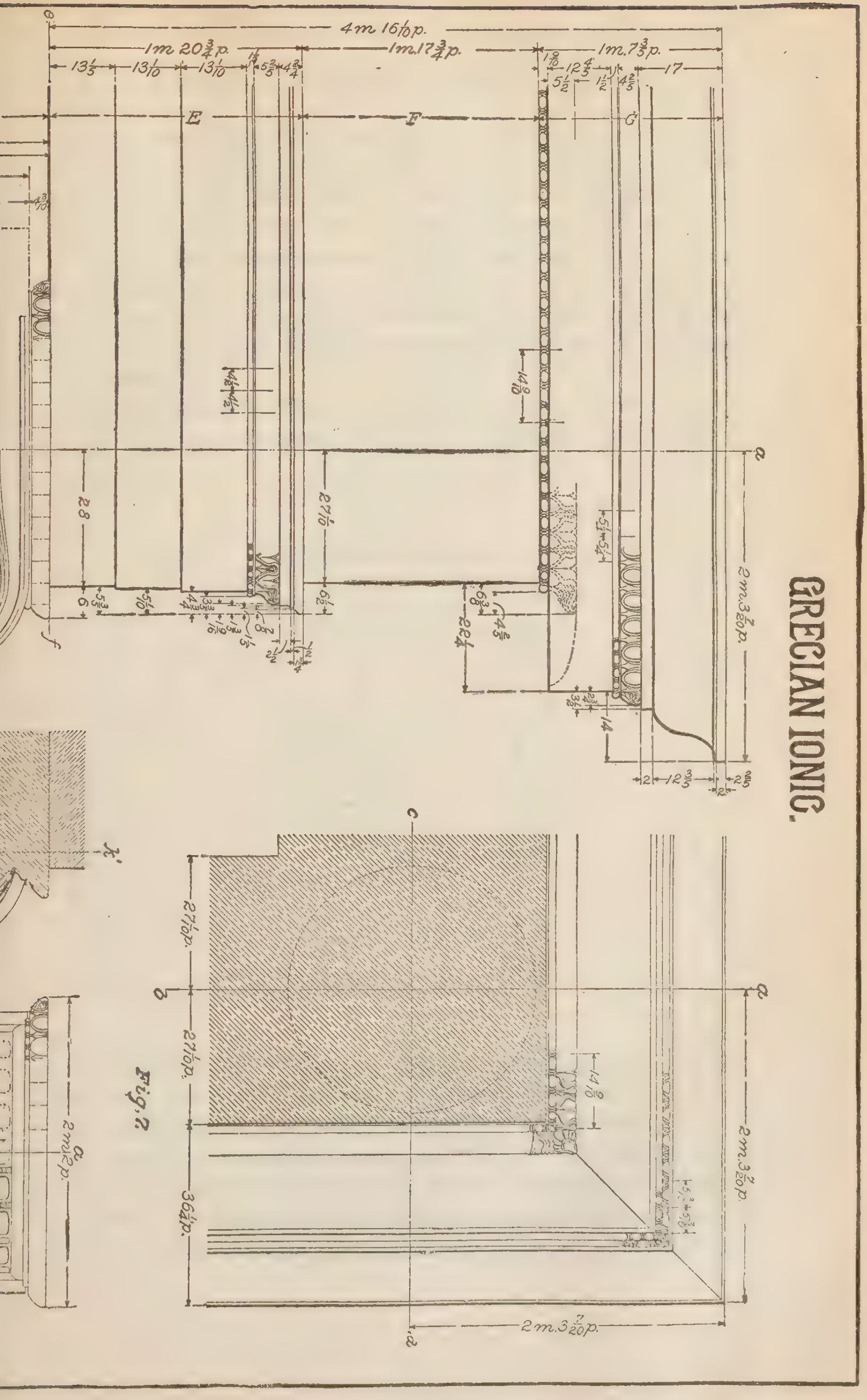

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measurements given, but omitting, for the present, the ornament on the cyma reversa. The frieze in this order, it will be observed, is a plain band, devoid of any triglyphs or metopes, as in the Doric, while the corona consists of a group of simple moldings, elaborated with surface ornament. Carefully draw these details, profiling their outline where they project at the return of the entablature, but omitting the ornament until the outlines of the other figures on the plate are complete.

The capital *D* is the most complicated feature of the Ionic order. It consists essentially of a contracted echinus and a small torus, over which the *volutes*, or spirals, are turned, forming the distinctive characteristic of the order. A necking under the capital, which is usually decorated with carved ornament, is separated from the shaft of the column by a narrow fillet, or bead molding, called the *astragal.* Before drawing the capital, the student should practice the volute on a separate piece of paper until he becomes familiar with the

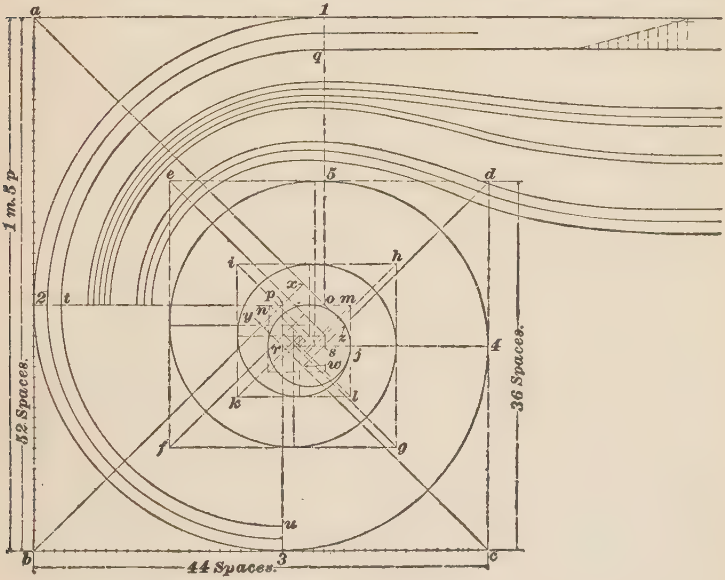


FIG. 5

mathematical system of its lines. In Art. **14,** *Ornamental Drawing*, a method of laying out the construction lines for the volute is given, the curve being drawn freehand. In Fig. 5 of the text, the lines *a b*, *b c*, and *c d* are laid off in the proportion of 6½ to 5½ to 4½, and for the convenience of this proportion *a b* is divided into 52 equal parts; *b c* will then be 44 of these parts, and *c d* 36 parts in length. The lines *d e*, *e f*, *f g*, *g h*, etc. are all laid off in the same manner as were corresponding lines of the volute described in Art. **14,** which gives *d e* 31 parts; *e f*, 26 parts; *f g*, 22 parts; *g h*, 18 parts; etc. *a z* is then drawn at an angle of 45° with *a b*, and *b x*, *c y*, and *d w* are also drawn, each at an angle of 45° with the line from whose extremity it starts. The intersections of these four lines will form a square *w y x z*. The line *x z* is then bisected at *o*, and the arc *1–2* is drawn with the radius *o 1*. The line *x y* is then bisected at *p*, and the arc *2–3* is described with the radius *p 2*. The lines *y w* and *w z* are then bisected in *r* and *s*, and the arcs *3–4* and *4–5* are described in the radii *r 3* and *s 4*. This completes the first convolution of the spiral.

The second convolution is described in precisely the same manner, by forming another square at the intersection of the four lines drawn at an angle of 45° from *e*, *f*, *g*, and *h*, and the third and last convolution is described from the square formed at the center, by lines drawn at 45° from *i*, *k*, *l*, and *m*. The radius of the *eye*, or central disk, is then obtained by dividing the distance from the finish of the last arc at *j* to the point *1*, the start of the first arc, into 8 equal parts. With one of these parts as a radius, and with a center on the line *r j*, a circle is then drawn which is tangent to the last arc at *j*.

The bands *q* are drawn by setting off their dimensions on the line *o 1* as at *q 1* and dividing the distance *q 1* into 11 equal parts. The width of the band at *2* will be 10 of these parts, and at *3* it will be 9 parts, and so on all the way round until the bands become tangent at *j*. To draw the bands, place one leg of the compass at *o* and set the pencil point for the radius *o q*; then, with a center on the line *o t*, and a radius $o q$, describe the quadrant $q t$; then, with a center on the line $p u$, and a radius $p t$, describe the arc $t u$, and so on to the completion of the bands.

Having drawn the volute on a separate sheet of paper, and to a large scale, proceed to draw it on the plate. Lay off below $e f$ $4\frac{3}{10}$ p. for the thickness of the abacus, and draw a horizontal line; perpendicular to this line, and $44\frac{4}{5}$ p. from the center line $a b$, draw the first construction line of the volute 35 p. in length. Then proportion the lines in the ratio of $6\frac{1}{2}$ to $5\frac{1}{2}$ to $4\frac{1}{2}$, which will make the first three approximately 35 p., 30 p., and 24 p.; and, proceeding as described for Fig. 5, complete the construction lines of the volute, on both sides of $a b$. Then draw in, on the right-hand side, the curves of the volute and its bands.

Where these bands dip down at the center of the capital, a number of points should be laid off according to the scale of modules, and the curves first sketched freehand and afterwards strengthened with the irregular curve. The egg-and-dart ornament on the echinus, and the guilloche on the torus, may now be drawn in between the volutes, and the egg-and-dart on the echinus and water-leaf ornament on the cymas of the entablature. The cyma reversa, shown in *dotted lines* under the corona of the cornice, is so drawn because it is *undercut*, or recessed, behind the lower face of the corona, and is therefore not seen on the elevation of the order, though it appears in the perspective, Fig. 4, as the view of the cornice is there taken from below. Now proceed with Fig. 2, which is a half plan of the column, looking upwards. Draw $i j$ at right angles to $a b$, and $4\frac{5}{16}$ inches above the lower border line. With a center on the point of intersection of $i j$ and $a b$, and with a radius of 25 p., draw a semicircle, as shown. Divide the circumference of this semicircle into 12 equal parts, and on each of these points of division as a center, and with a radius of $2\frac{5}{8}$ p., describe a semicircle, which will be the plan of the flutes, while the spaces between these semicircles, where they intersect the circumference of the shaft, will be the fillets between the flutes. Now project the lines of these flutes to the elevation of the capital and neck of the column, and draw their semicircular finish against the fillet under the column neck. To draw the flutes on the section of the shaft immediately over the base, it will be necessary first to draw Fig. 6, which is a half plan of the column and base. Draw the line *c d* 3 inches above, and parallel to, the lower border line, and at right angles to *c d* draw *a b* $2\frac{3}{4}$ inches from the right-hand border line. On the intersection of *a b* and *c d* as a center, and with a radius of 1 m., draw the semicircular outline of the column; divide the circumference of this semicircle into 12 equal parts, and with the points of these divisions as centers, and a radius of $3\frac{1}{8}$ p., draw the semicircular flutes and the fillets between them. Then draw the plan of the moldings according to the measurements given in Fig. 1, and the plan of the stylobate, which extends $3\frac{1}{2}$ p. beyond the lower torus of the base. Project the lines of the flutes and fillets to *c d*, and transfer their position to the lower section of the column in Fig. 1. Now complete the flutes and fillets in Fig. 1, drawing their finish on the apophyge of the shaft, partly with the bow-pencil and partly freehand, as the case may require. Return to Fig. 2, and draw the under side of the capital as shown. The portions of the volutes seen in the elevation are here observed to be but $2\frac{1}{3}$ p. in thickness, while the material behind the volute is hollowed out towards the shaft, and is ornamented with rows of bead molding and fillets. This portion of the capital is called the *bolster*, and its appearance in section, on the line *i j*, may be seen in Fig. 4, while a section through the capital between the volutes on the line *a b* is shown in Fig. 5.

Now draw Fig. 3, which is a side elevation of the capital, showing the bolster. Draw the center line *a b* at a distance of $2\frac{3}{16}$ inches from, and parallel to, the right-hand border line. Project from Fig. 1 the horizontal lines of the abacus, and the locations of the small torus, echinus, and fillet of the capital, which show on the front elevation between the volutes. Project also the lines defining the depth of the volutes and the fillet immediately under the bead molding. On this fillet line lay off, on each side of the center line $ab$, a distance of 24 p., and on $ab$ each side of the fillet line lay off $7\frac{1}{2}$ p.; then construct an ellipse 48 p. long and 15 p. wide, as shown. This ellipse will define the outline of the bottom of the bolster. Draw the bead moldings on the bolster according to the measurements given in Fig. 2, and complete the figure.

Now draw Figs. 4 and 5. The lines defining the depths of the members on Fig. 4 should be projected from Figs. 1 and 2, and the projection of these members from the center of the column may be obtained from Fig. 2. The face line of the column is shown in Fig. 4 at $k'l'$, and in Fig. 5 at $kl$. The heights of the moldings on this line may be scaled from Fig. 1 or transferred by means of a strip of paper. The projection of the abacus, torus, and echinus may be obtained from Fig. 3, but the other details should be scaled from the figure itself.

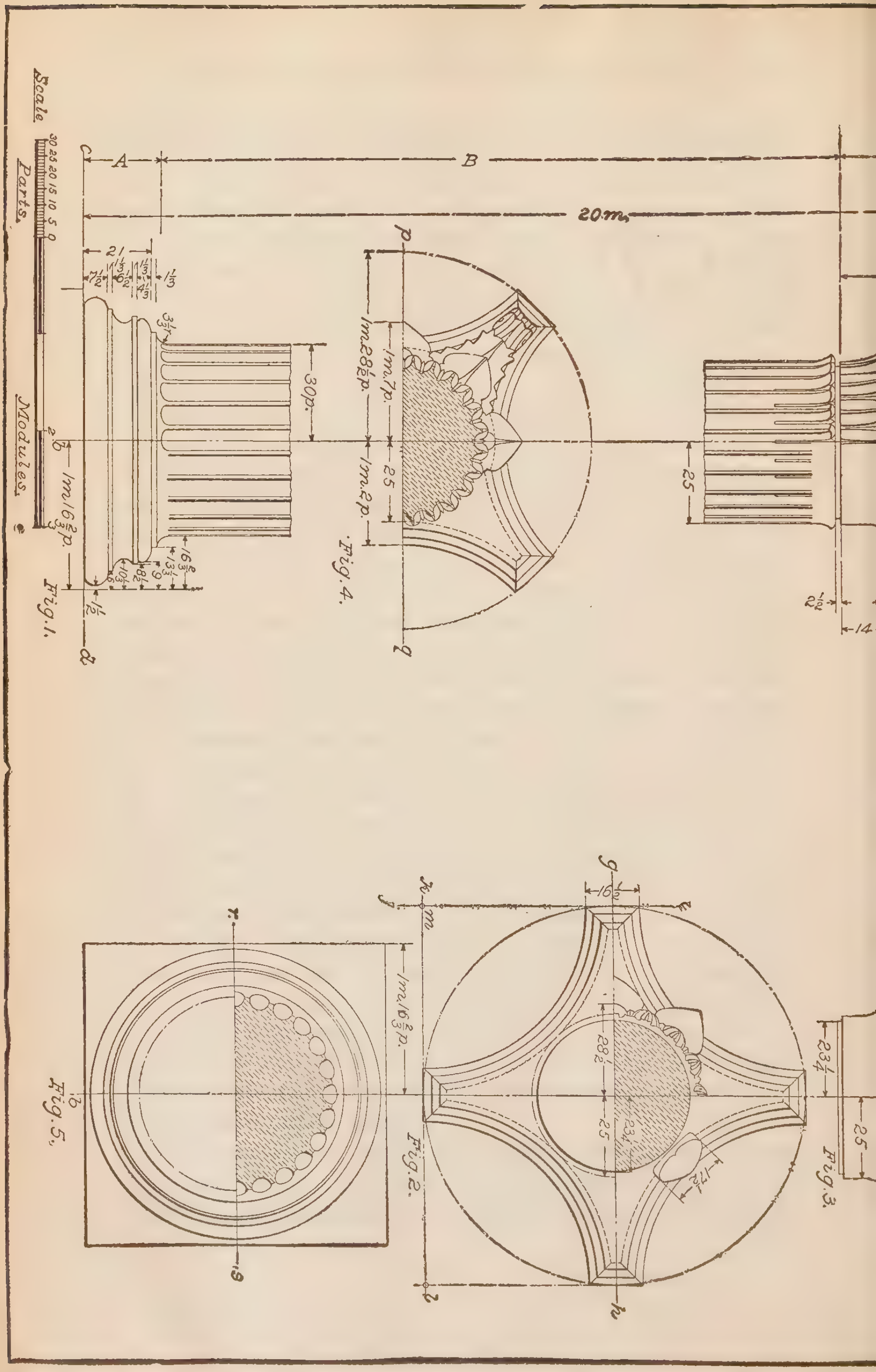
Now draw Fig. 7, which is a plan of the under side of the entablature, looking upwards from a section line through the frieze. Draw the center line $ab$ at a distance of $3\frac{1}{16}$ inches from the right-hand border line, and at right angles to $ab$ draw $cd$ $4\frac{3}{16}$ inches from the upper border line. With the point of intersection of these lines as a center, and with a radius of 25 p., draw a circle, which will be the plan of the top of the shaft of the column; then measure off on $ab$ $27\frac{1}{10}$ p. above $cd$, and measure off on $cd$ $27\frac{1}{10}$ p. to the right of $ab$; through the points so located draw a horizontal and a vertical line to define the projection of the frieze. Then, from the frieze line measure off the projections of the various members of the cornice, and draw lines defining these members. Draw the miter lines where the cornice members intersect at the angle, and complete the figure.

Now proceed to draw the ornamentation of the moldings of all the figures, cross-hatch the parts shown in section, and complete the plate, carefully inserting all the dimensions, but omitting all the reference letters, except those shown in capitals, which refer to the main subdivisions of the order.

## DRAWING PLATE, TITLE: GRECIAN CORINTHIAN

**5.** On this plate the stylobate is omitted, and *A*, *B*, and *C* show the base, shaft, and capital of the column, while *D*, *E*, and *F* are the architrave, frieze, and cornice of the entablature. The plate is to be drawn to a scale of $1\frac{1}{2}$ inches = 1 foot, and the diameter of the column being 15 inches, the module is consequently $7\frac{1}{2}$ inches in length. The column is much more slender than the Doric or Ionic, and the capital is higher and more richly ornamented, as may be seen in Fig. 6 of the text, though the entablature is but slightly modified from the Ionic. Construct a scale of modules, as shown on the plate, locating it $\frac{5}{16}$ inch above the lower border line, and $1\frac{1}{4}$ inches from the left-hand border line. Commence Fig. 1, the elevation of the order, by drawing the center line $a\,b$ at a distance of $4\frac{1}{8}$ inches from, and parallel to, the left-hand border line. Draw the lower side of the base $c\,d$ $\frac{3}{4}$ inch, and the under side of the architrave $e\,f$ $10\frac{5}{8}$ inches, above the lower border line. On the center line $a\,b$ lay off a series of measurements locating the principal divisions of the column and entablature, and draw the horizontal lines defining them. Profile the moldings of the base according to the measurements given, and draw the side lines of the shaft, but omit for the present the fluting of the shaft. Draw the abacus of the capital and the three facias of the architrave, observing that the facias do not lie in perpendicular planes, but incline towards the interior, so that the outer edge of each is on the same perpendicular line as the one next above or below. Omit for the present the carving on the frieze, but draw the moldings over the frieze and locate the dentils in the cornice according to the measurements given. Over the dentil course is a cyma, and above this the corona; draw the echinus and fillet above the corona, and locate the antefixa and cresting which crown the entablature.

Now draw Fig. 2, which is a plan of the capital looking upwards. Draw the center line $a\,b$ (which is common to Figs. 2, 3, and 5) at a distance of $2\frac{1}{2}$ inches from, and parallel



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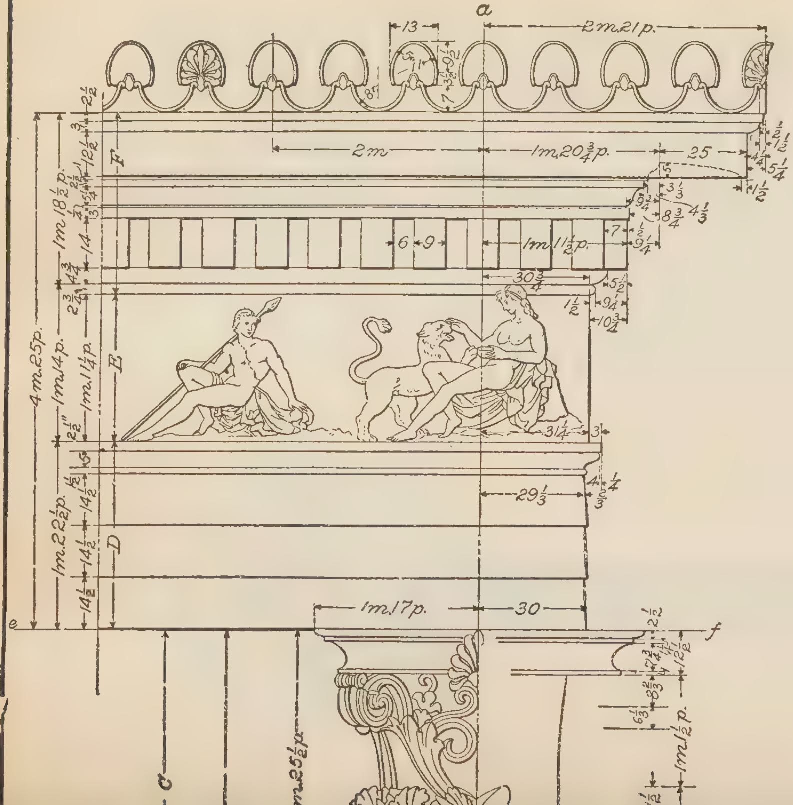


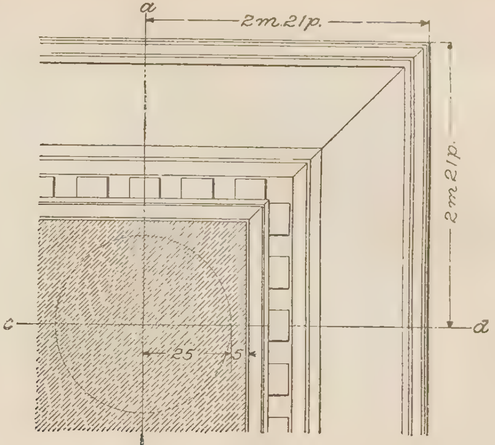
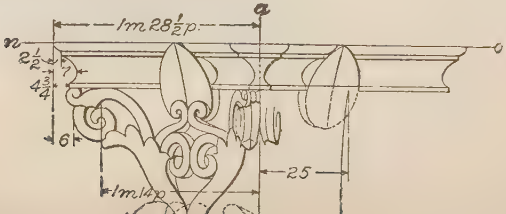


Fig. 6.



to, the right-hand border line, and draw *g h* $5\frac{13}{16}$ inches above the lower border line. From the point of intersection of these lines, and with a radius of $23\frac{1}{4}$ p., draw the circular outline of the bell of the capital, as it would appear in section, at the top of the first row of leaves; and, with a radius of 1 m. $28\frac{1}{2}$ p., draw a circle limiting the projection of the angles of the abacus. From the intersection of this circle with the axial lines *a b* and *g h*, lay off the width of the projecting angles, and draw *i j* and *k l* tangent to the circle at its intersections with the axial lines. Then *i j* and *k l* will intersect at *m*. Now, with *m* as a center, and a radius of 1 m. $20\frac{1}{4}$ p., describe an arc, which will be one of the sides of the abacus, between the angles. Draw this arc on the four sides, and then increase the radius and draw the arcs of the moldings of the abacus. Locate on the concave sides the block outline of the ornament on the abacus, which is shown in the *elevation*, Fig. 1, to the left of the center line *a b*. It will be observed that, while the abacus in the Doric order is simply a square slab, and in the Ionic order a slab with

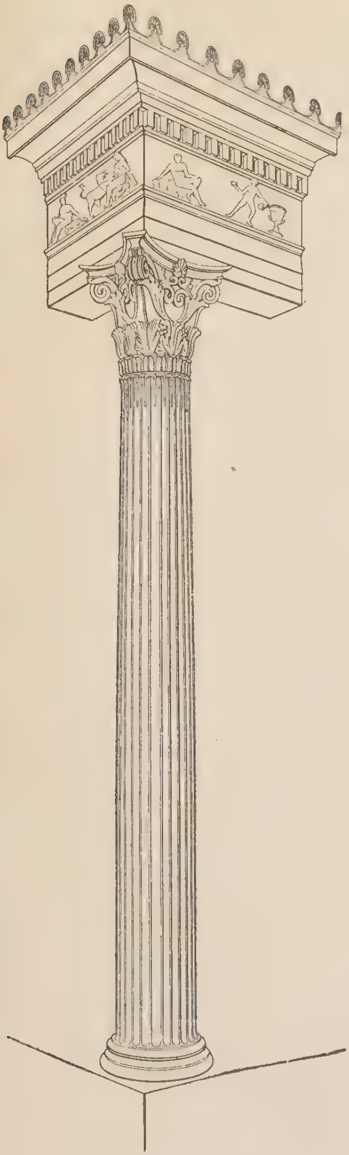


FIG. 6

molded edges. in the Corinthian order it is deeply hollowed and molded on its sides, and its angles are cut off on straight lines at right angles to the axes.

To draw Fig. 3, which is an elevation of the capital, from an angular point of view, project the horizontal lines of the abacus from Fig. 1, and its breadth across the angles, from Fig. 2. Draw in the leaves and ornament from the dimensions given. The foliated ornament on the Corinthian capital consists of a number of *caulis*, or husks, out of which the *cauliculi*, or twisted stems, spring, forming small spirals or volutes at the sides and angles of the abacus. The body of the capital on which this foliage is arranged is called the *bell*, or core. Now proceed with Fig. 4, which is a plan of the capital similar to Fig. 2, but taken as it would appear from a section through the shaft of the column, and placed in the position that it bears to the elevation in Fig. 1. Draw twenty-four semicircular flutes in this plan, leaving a fillet between each pair of flutes, equal to one-fourth the width of the flute, and project the lines of these flutes and fillets to Fig. 1, as shown. It will be observed that the flutes and fillets terminate in leaf forms where they join the capital, and that the central vein of each leaf is the termination of the fillet; also, that between each pair of leaves another vein extends down into the flute itself. Draw these veins in the flutes shown in Fig. 4, and also the projection of the leaves over the edges of the fillets.

Now finish the foliage in the capital, Fig. 1, laying out the design in a set of squares if desired, and drawing the leafwork freehand. Draw the plan of the base as shown in Fig. 5, locating the line $rs$ $2\frac{3}{16}$ inches above the lower border line. On the intersection of $ab$ and $rs$ as a center, and with a radius of 1 m., draw the circular outline of the shaft, and divide it into 24 parts, each of which will include one flute and one fillet. Draw twelve of these flutes and fillets, and with a strip of paper transfer their projection to Fig. 1; then draw the elevation of the flutes on the lower part of the column. Draw the circular outlines of the base moldings in Fig. 5, from the measurements given in Fig. 1, and the square plinth under the base, which is 1½ p. wider on each side than the lower torus of the base.

Draw Fig. 6, locating the line *a b* 3½ inches from the right-hand border line, and *c d* 3¾ inches from the upper border line. With the intersection of these lines as a center, and with a radius of 25 p., draw the circular outline of the top of the column. Draw the extreme lines of the projection of the cornice, 2 m. 21 p. from the center lines, and locate the other members of the cornice from the dimensions given in Fig. 1.

Draw the carved ornament on the frieze in Fig. 1, by a system of squares, cross-hatch all parts shown in section, draw the dimension lines and put in the dimensions, and complete the plate as shown.

## DRAWING PLATE, TITLE: TUSCAN ORDER

**6.** This plate shows the elevation and details of the first of the Roman orders. There are five of these orders, and, although they vary materially from their Greek prototypes, they are similar to them in their principal characteristics. The Tuscan order, a perspective view of which is shown in Fig. 7 of the text, is the simplest of the five, and was probably, in its original form, an imitation of the Greek Doric. With the exception of the Tuscan, the Roman orders are all much more elaborate than those of the Greeks, and in all five we find the stylobate supplanted by a regularly designed pedestal on which the column stands. The moldings of the Roman orders are always profiled with the arcs of circles, while the Greeks usually molded their sections to the arc of a parabola or hyperbola. Other modifications exist in each order, which will be pointed out as they appear in the following plates. The following five plates are all drawn to a scale of 1½ inches = 1 foot, but, as the diameters of the columns differ, the lengths of the modules differ correspondingly, and a separate scale must be prepared for each plate.

In the Roman orders, the pedestal is always one-third, and the entablature one-fourth, the height of the column;

but the proportions of the details of these main divisions are subject to wide variations in the different orders. In each of the following five plates, the pedestal is shown at *A B C*, where *A* is the base, *B* the die, or body, and *C* is the cornice of the pedestal. *D*, *E*, and *F* show the base, shaft, and capital of the column, and *G*, *H*, and *I* indicate the architrave, frieze, and cornice of the entablature.

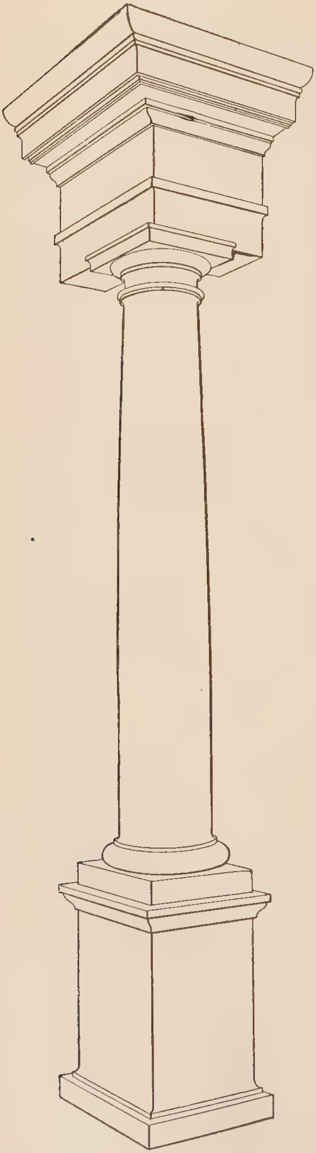


FIG. 7

Commence this plate by constructing a scale 4 m. in length, at a distance of $\frac{5}{16}$ inch above the lower border line, the module upon this plate being equal to 10 inches. Then draw *a b*, the center line of Fig. 1, at a distance of $4\frac{1}{8}$ inches from, and parallel to, the left-hand border line. Lay off on *a b* the horizontal divisions of the order, according to the dimensions given on the plate; profile the moldings of the capital and base of the column, and also at the returns of the entablature and pedestal, striking all the curves with the bow-pencil, and from centers located according to the measurements given on the plate.

Now draw Figs. 3 and 4, which are plans of the under side of the capital and of the upper side of the base, respectively, locating the center line *a'' b''* at a distance of $2\frac{1}{2}$ inches from, and parallel

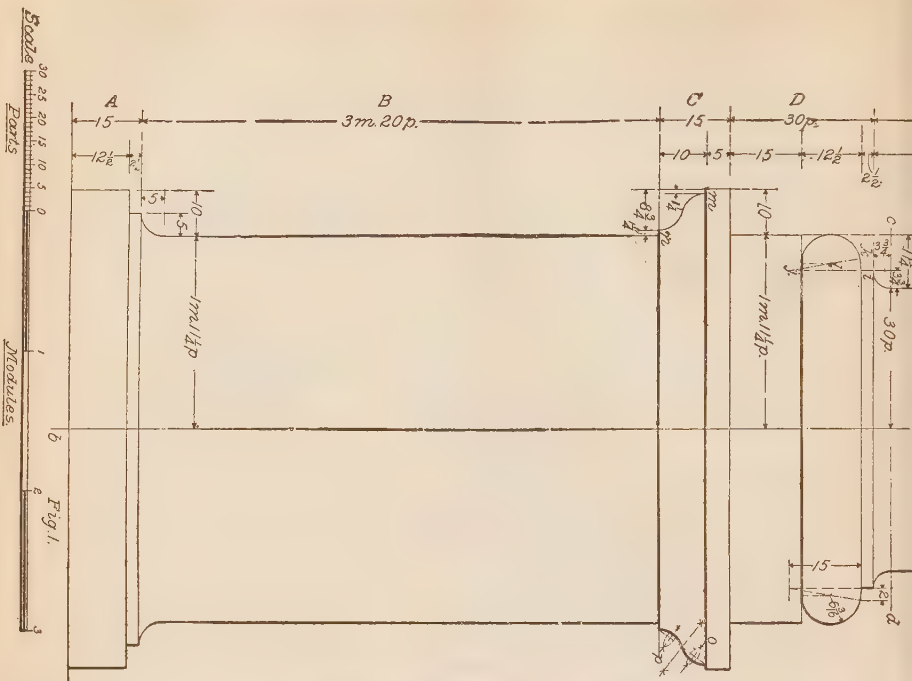


Fig.1.

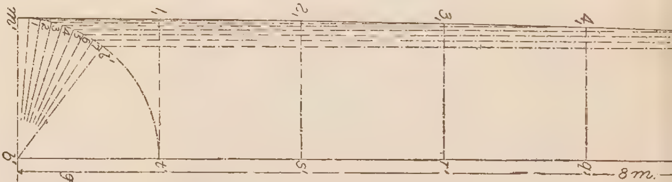


Fig.5.

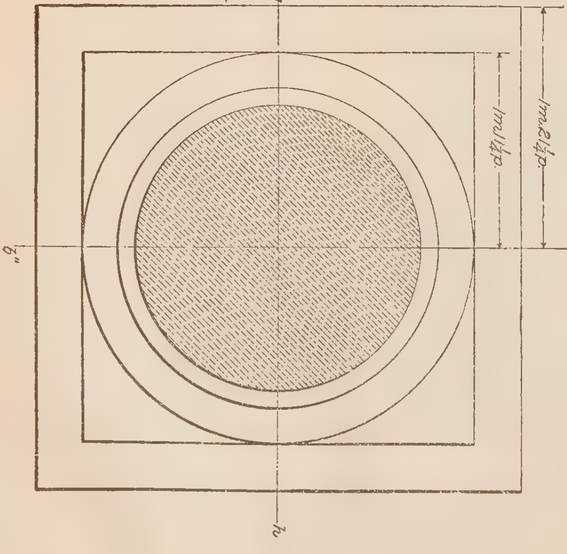


Fig.4.

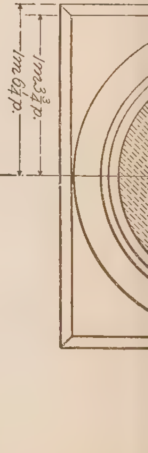


Fig.3.

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# TUSCAN ORDER.

Scale 1½" = 1 ft.

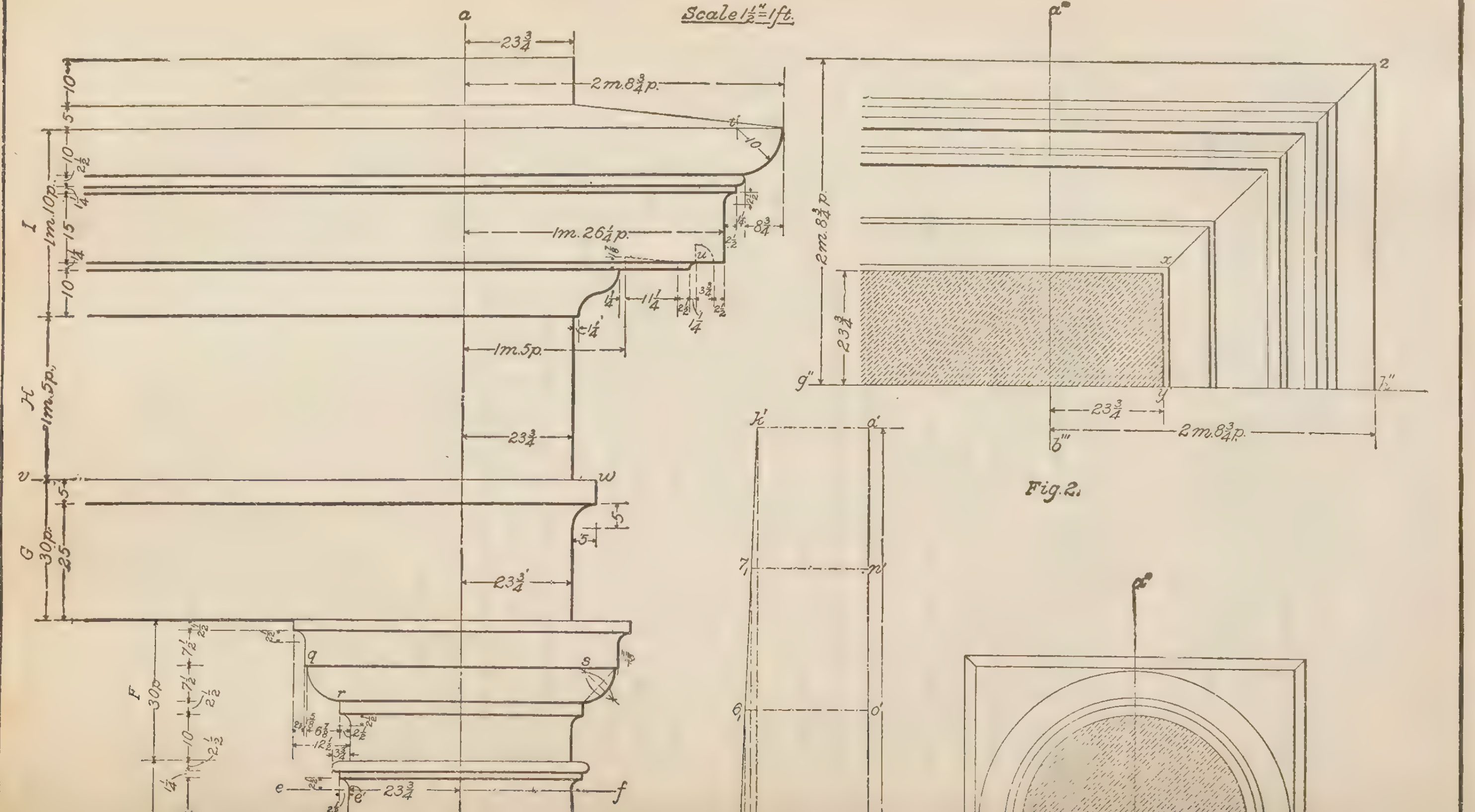


Fig. 2.

to, the right-hand border line; and the lines $g'h'$ and $gh$, $8\frac{7}{8}$ inches and $2\frac{7}{8}$ inches, respectively, above the lower border line. Draw the circular outlines of the moldings on the capital and base, in Figs. 3 and 4, from measurements taken from Fig. 1, and complete the figures. Then draw the soffit, or under side of the entablature, shown in Fig. 2. Locate the center line $a'''b'''$ $3\frac{5}{8}$ inches from, and parallel to, the right-hand border line, and draw $g''h''$ $4\frac{1}{4}$ inches below the upper border line; then, from the dimensions given on Fig. 1, complete Fig. 2, as shown.

Fig. 5 is a half elevation of the upper part of the shaft of the column, showing the method of profiling the curved outline of the shaft, which is called the **entasis.** The architectural purpose of the entasis is to prevent the shaft of the column from appearing too slender, and to destroy the optical illusion of concave sides, which is likely to appear when the lines of a shaft are parallel. Draw the center line $a'b'$ $5\frac{1}{4}$ inches from the right-hand border line, and 8 m. in length; then divide it into 8 equal parts of 1 m. each. Through these points of division draw the horizontal lines $t'1'$, $s'2'$, $r'3'$, etc. Now, on $b'$ as a center, and with a radius of 1 m., draw the arc $m't'$. Make $a'k'$ $23\frac{3}{4}$ p., or one-half the upper diameter of the column. From $k'$ draw $k'l'$ parallel to $a'b'$ and intersecting the arc $m't'$ at $l'$. Divide the arc from $m'$ to $l'$ into 8 equal parts, as shown at $1$, $2$, $3$, etc., and from each of these points of division erect a perpendicular line, to intersect with the horizontal lines drawn through $n'7_1$, $o'6_1$, $p'5_1$, etc.; then through the points $k'$, $7_1$, $6_1$, $5_1$, etc. draw the curve of the entasis.

Now finish the plate, putting in all dimensions and dimension lines, but omitting all reference letters except those on Fig. 5.

## DRAWING PLATE, TITLE: DORIC ORDER

**7.** The Roman-Doric order, Fig. 8 of the text, though similar in many of its details to the Greek order of the same name, as shown in Fig. 1, is, as a whole, so modified that it would hardly be recognized as a descendant of the Grecian design. The stylobate here is in the form of a pedestal, and the column stands upon a molded base, which never existed in the Greek Doric. The flutes of the shaft are somewhat similar to those of the Greek order, but are composed of circular instead of elliptical arcs. The capital is decidedly different, and though the frieze still possesses the triglyphs and metopes, these details are differently proportioned and less regularly spaced than in the Greek order. The mutules are level on their under sides, and the crowning member of the corona is a cyma recta instead of an echinus.

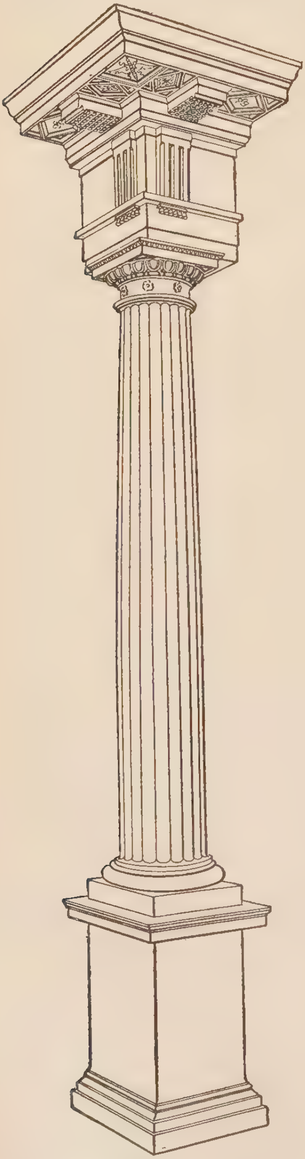
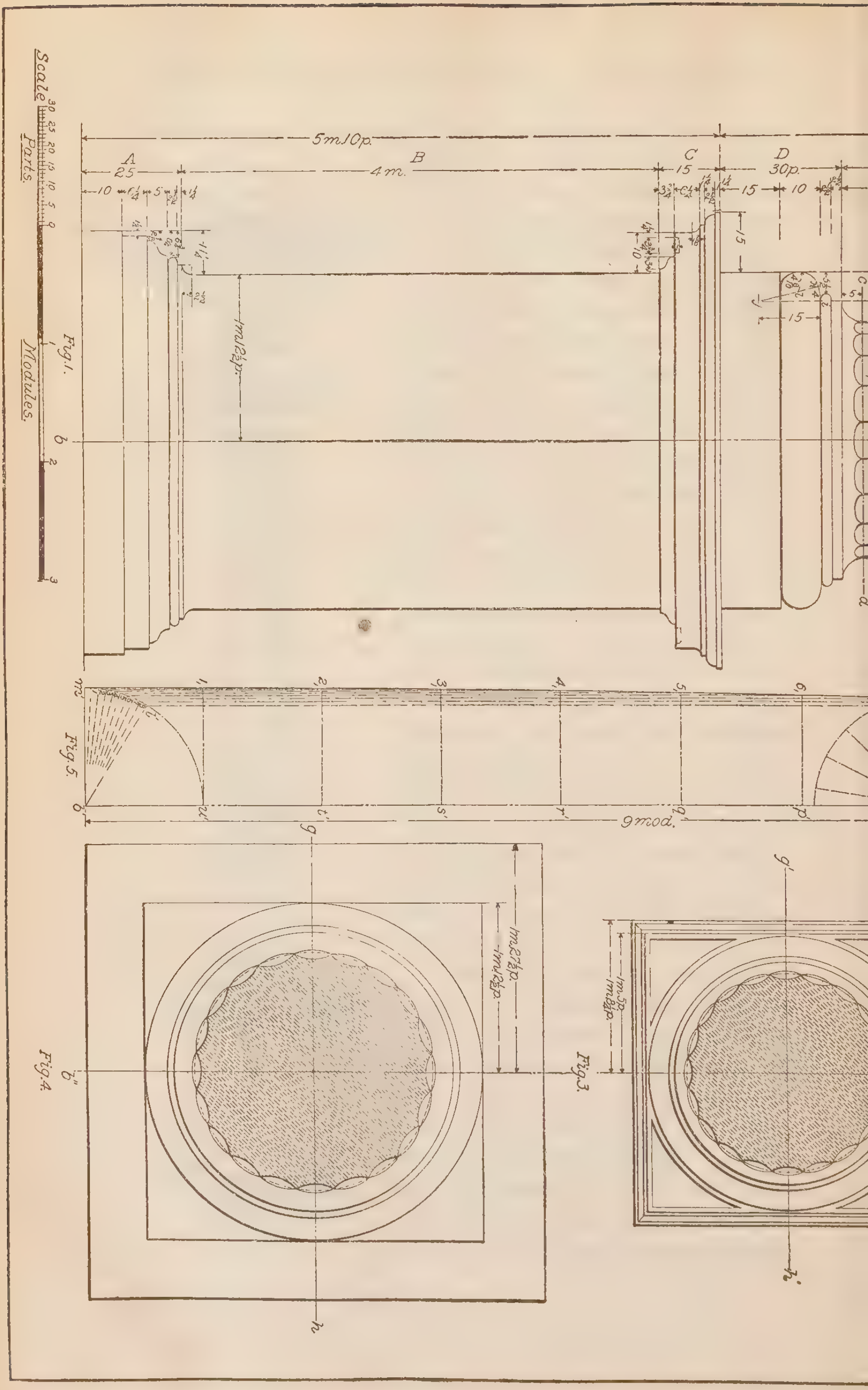


Fig. 8

Commence this plate by constructing a scale of modules $\frac{5}{16}$ inch above the lower border line. The diameter of the column being 18 inches, the module will be 9 inches, and the scale should be made 4 m. in length, with the first module divided into 30 p. as shown.

Draw *a b*, the center line of Fig. 1, at a distance of $4\frac{1}{8}$ inches from, and parallel to, the left-hand border line. Measure off on *a b* the horizontal divisions of the order, and draw the lines defining these divisions. Profile the moldings of the pedestal, column, and entablature according to the measurements given,



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# DORIC ORDER.

Scale 1½" = 1 ft.

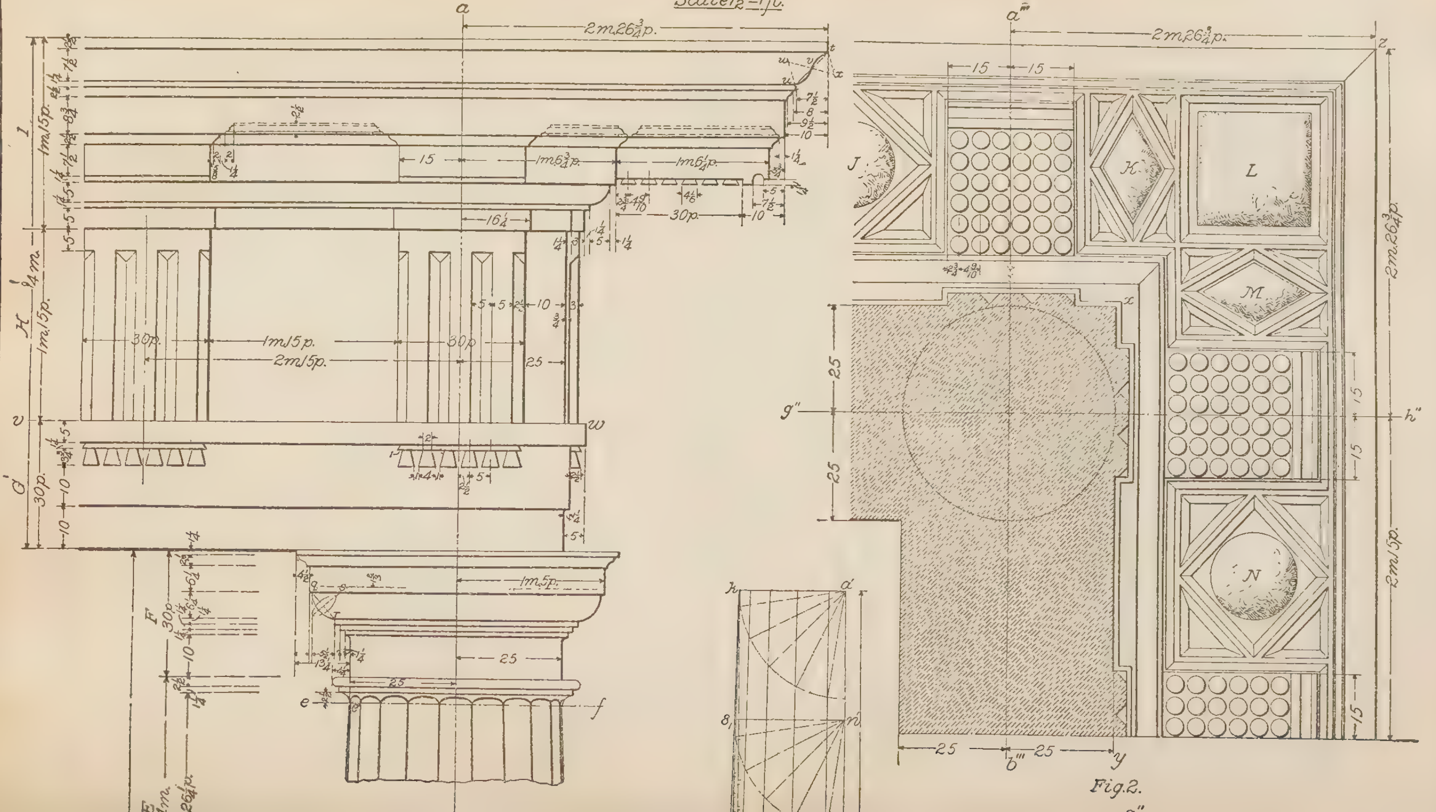

Fig. 2.

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and draw the triglyphs and mutules in the entablature. Complete Fig. 1, omitting for the present the fluting of the shaft. Now draw Figs. 3 and 4, which are plans of the under side of the capital and upper side of the base, respectively. Draw the center line $a'' b''$ $2\frac{7}{8}$ inches from, and parallel to, the right-hand border line. Draw $g h$ $2\frac{7}{8}$ inches and $g' h'$ $7\frac{3}{8}$ inches above the lower border line. Draw the circular plan of the moldings of the base and capital and the circular plan of the shaft. Draw the rectangular outlines of the moldings on the abacus in Fig. 3, and of the plinth and pedestal in Fig. 4. Divide the circumferences of the circles defining the plan of the column in Figs. 3 and 4 into 20 equal parts, and with the chord length of one of these parts as a radius, describe the arcs defining the flutes. Project the arrises between these flutes to the lines $g h$ and $g' h'$, and with a paper strip transfer their positions to Fig. 1.

Draw Fig. 2, which is a plan of the under side of the entablature, locating the center line $a''' b'''$ 4 inches from, and parallel to, the right-hand border line, and draw $g'' h''$ $4\frac{1}{2}$ inches below the upper border line. Draw in the moldings and plans of the mutules from the dimensions given in Fig. 1, and carefully outline the panels *J*, *K*, *L*, *M*, and *N* between the mutules.

Draw Fig. 5 in the same manner as described for the previous plate, locating the center line $a' b'$ $5\frac{3}{8}$ inches from the right border line, and making it 9 m. in length, instead of 8 m. as before, and dividing the arc $m' l'$ into 9 equal parts.

On $a'$, $n'$, $o'$, etc. as centers, and with $a' k'$, $n' 8_1$, $o' 7_1$, etc. as radii, describe quadrants as shown, and divide each quadrant into 6 parts, the first and last division being 9° each, and the intermediate divisions 18° each. These points of division will locate the positions of the arrises between the flutes, on the lines $a' k'$, $n' 8_1$, etc. Project these points from the circumferences of the quadrants to the lines from which the quadrants start, as $a' k'$, $n' 8_1$, etc., and through them draw the lines of the flutes of the shaft as shown.

Fig. 5 shows only the upper two-thirds of the column, as the sides of the lower third are parallel. Now complete Fig. 1, drawing the flutes in the upper part of the column from measurements taken from Fig. 5, and in the lower part of the column from measurements taken from Fig. 4, as previously explained.

## DRAWING PLATE, TITLE: IONIC ORDER

**8.** The Roman-Ionic order differs from the Grecian order, principally in the formation of the volutes of its capital, and the addition of the pedestal, as may be seen by comparing Fig. 9 of the text, which is a perspective of the Roman-Ionic order, with Fig. 4, the perspective view of the Greek Ionic.

The column in this plate is 16 inches in diameter, and the module is consequently 8 inches. Construct a scale 4 m. in length, $\frac{3}{8}$ inch above the lower border line; then commence Fig. 1 by drawing the center line $a\,b$ $4\frac{1}{8}$ inches from, and parallel to, the left-hand border line. Lay off on $a\,b$ the horizontal divisions of the order, and draw the lines defining these divisions. Complete Fig. 1 from the measurements given, except the flutes of the shaft and the volutes of the capital.

Now draw Fig. 6, which is an elevation of the volute of the capital, four times the size of this detail in Fig. 1, or according to a scale of 6 inches = 1 foot. Draw $k\,l$ 3 inches from, and parallel to, the right-hand border line, and $i'\,j'$ $9\frac{1}{8}$ inches above the lower border line. From the intersection of these lines lay off on $k\,b$ 15 p. towards $k$, and draw the horizontal line $1_1$–$1_2$; divide the distance from $1_1$ to the intersection of $k\,l$ and $i'\,j'$ into 8 equal parts, and, with one of these parts as a radius, and with a center at the point of intersection, describe a circle, which will be the eye of the volute.

The method of drawing the curves of this volute being essentially different from that practiced by the Greeks, it will be necessary for the student to leave Fig. 6 for the present, and give his attention to Fig. 7, which shows the

Fig. 1.

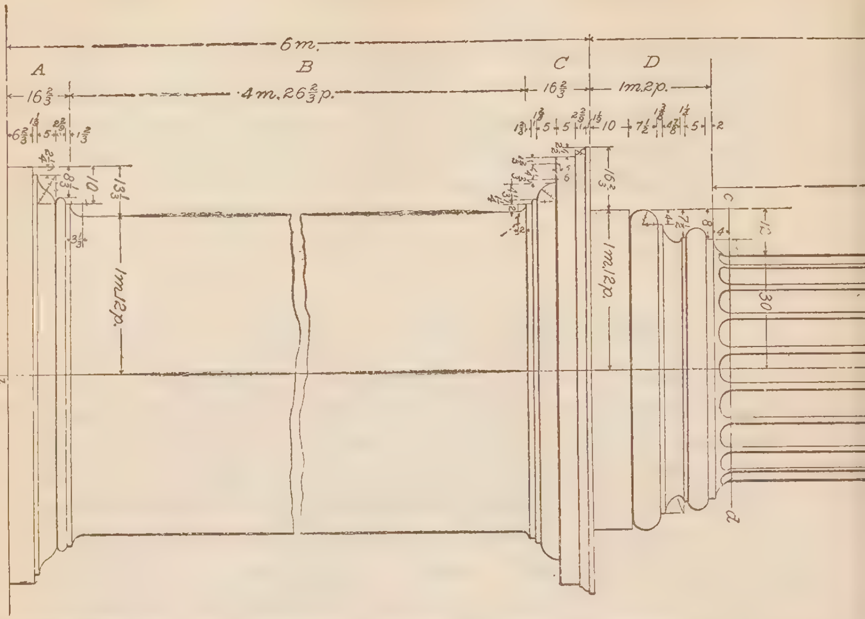


Fig. 5.

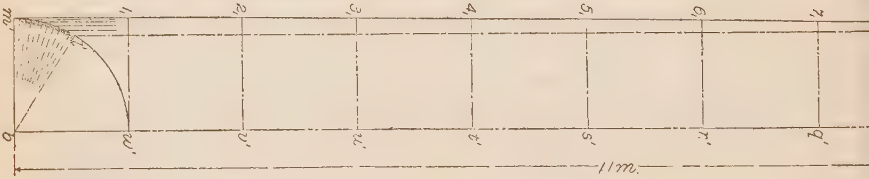


Fig. 4.

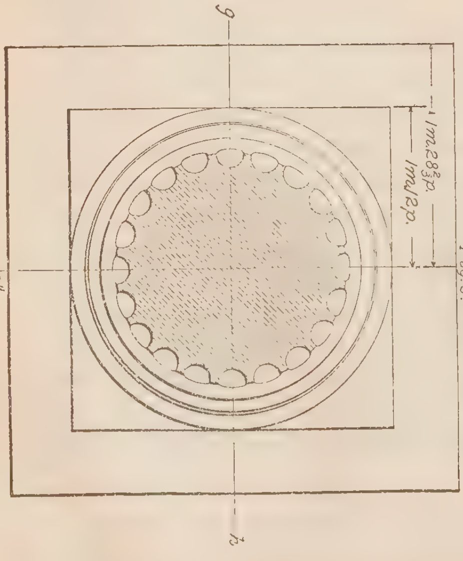


Fig. 3.

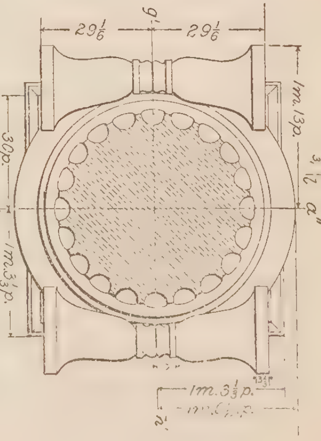
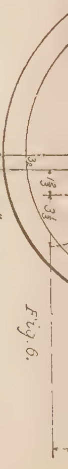


Fig. 6.



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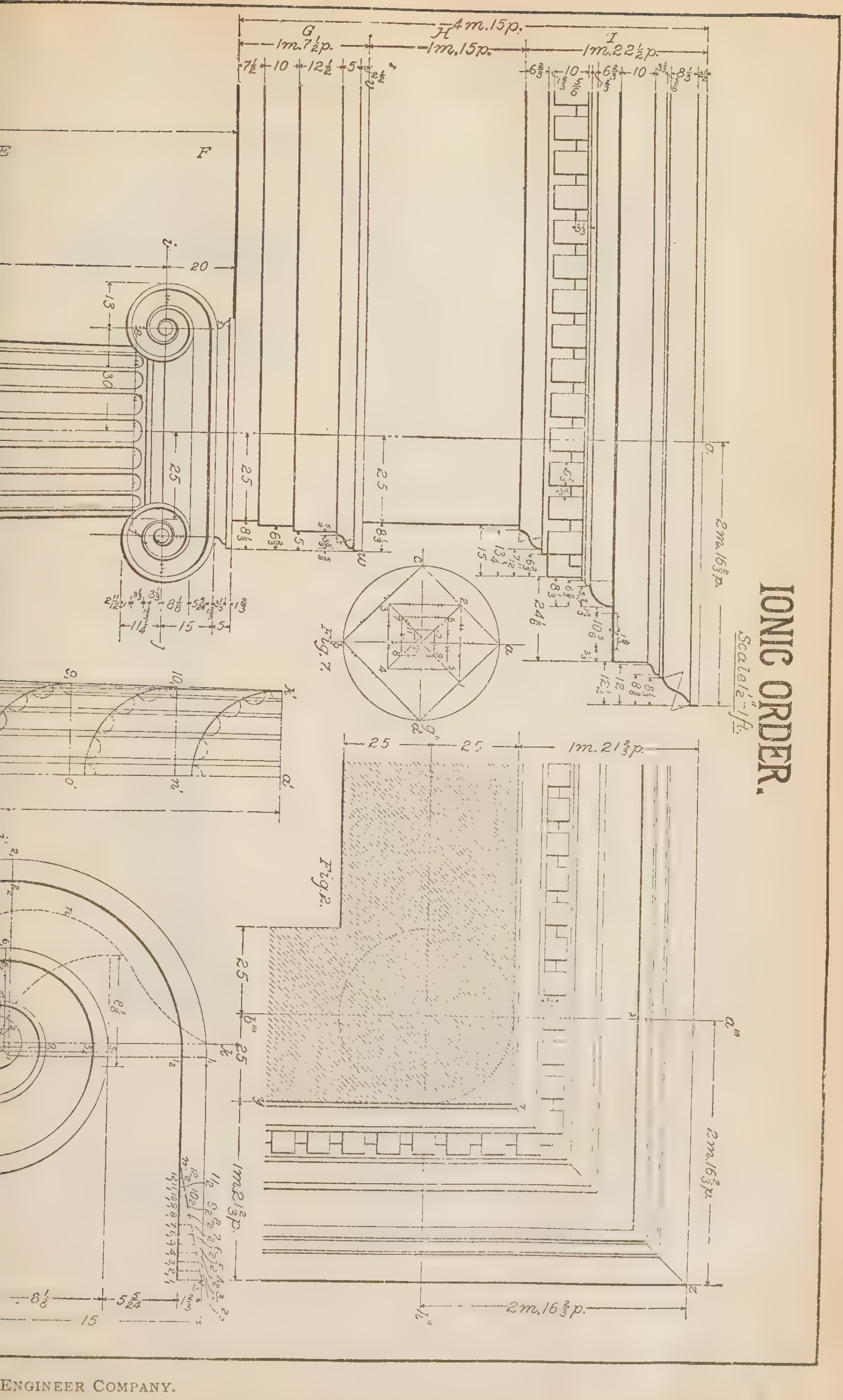


# IONIC ORDER.

Scale ½″ = 1 ft.

eye of the volute, drawn three times the scale of Fig. 6. Draw *a b*, Fig. 7, 6$\frac{7}{8}$ inches from, and parallel to, the right-hand border line, and draw *c d* at right angles to *a b* and 3$\frac{7}{8}$ inches below the upper border line. Now, with a radius of $\frac{3}{4}$ inch, and a center at the intersection of *a b* and *c d*, draw a circle whose diameter will be three times that of Fig. 6; then draw the lines *a c*, *a d*, *b c*, and *b d*; bisect *a c* and *a d* in points *2* and *1*, respectively, and draw radial lines from these points to the center of the circle; divide the line *2–12* into 3 equal parts, marking points at *6* and *10*. Through points *2*, *6*, and *10* draw lines parallel to *c d*; the vertical distance between the lines *2–1* and *c d* will then also be divided into 3 equal spaces. Now draw the line *3–4* at a distance from *c d* equal to 2$\frac{1}{2}$ of these spaces; from points *2* and *5* draw vertical lines defining the points *3* and *4*; from the latter points draw diagonal lines at an angle of 45°, intersecting on line *c d*; draw verticals from *6* to *7*, *10* to *11*, and *9* to *8*, and horizontals from *7* to *8* and *11* to *12*, thus completing the figure. The centers for drawing the arcs of the volute are at *1*, *2*, *3*, *4*, etc., and will be used in the order in which they occur.

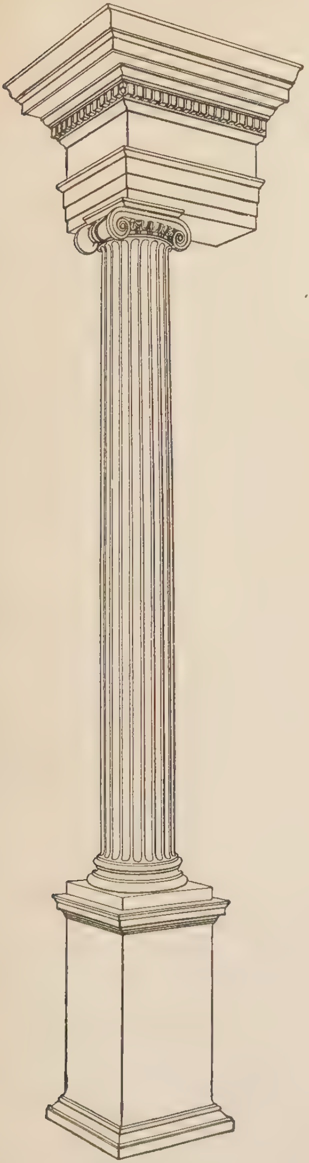


FIG. 9

Locate the centers in the eye of Fig. 6, by the method followed in Fig. 7, and proceed to draw the arcs. From center *1*, with a radius equal to $1-1_1$, draw the arc $1_1-2_1$; from center *2*, with a radius equal to $2-2_1$, draw the arc $2_1-3_1$, and continue thus until the outer line of the volute is complete. Before drawing the inner line of the fillet of the volute, which gradually diminishes to a point where it unites tangentially with the eye, it will be necessary to define its width at the end of each arc; draw the fillet line $1_2-1_1$ at a distance of $1\frac{2}{3}$ parts below the upper line $1_1-1_2$, and on it mark any point, as at *m*; divide the length of the line $m\ 1_1$ into 12 equal spaces, as $1_1-2_1$, $2_1-3_1$, etc.; join *m* and $1_2$ by an oblique line, as shown; from the points $1_1$, $2_1$, $3_1$, etc. draw vertical lines intersecting the oblique line at $1_2$, $2_2$, $3_2$, etc.; the length of the line $1_1-1_2$ being equal to $1_1-1_2$ at the springing of the volute, it need not be transferred, but with the dividers set to the distance $2_1-2_2$, transfer it to $2_1-2_2$ on the line $2_1-1$ at the end of the first arc, as shown; transfer these ordinates from the oblique line to the radial lines on the spiral, as shown, and in consecutive order.

Now, from the point $2_2$, on the horizontal line of the spiral $2_1-1$, mark a distance equal to the vertical line $1_2-1$; from the point marked, describe the arc $1_2-2_2$; then, from the point $3_2$ on the vertical line $3_1-2$, mark a distance equal to the horizontal line $2_2-2$, and from the point marked describe the curve $2_2-3_2$, continuing thus until the fillet of the spiral unites at the last convolution with the eye. Mark the widths of the moldings adjacent to the volute, and profile them as shown; the reverse curve *k n o* shows the curvature of the bolster on the center line *g′ h′* of Fig. 3.

Now draw the volutes and finish the capital in Fig. 1, and then proceed with Fig. 3. Draw *a b* $2\frac{1}{16}$ inches from, and parallel to, the right-hand border line; draw *g′ h′* $6\frac{1}{8}$ inches above the lower border line. Draw the upper circumference of the column; divide this circumference into 20 equal parts, and draw the fillets and flutes of the column, each fillet being one-third the width of a flute; draw the moldings of the neck and of the abacus, as well as the bolsters between the volutes, freehand. Now draw Fig. 4, the plan of the base and pedestal. Draw the center line $g h$ $2\frac{11}{16}$ inches above the lower border line, and with the point of its intersection with $a'' b''$ as a center, and a radius of 1 m., draw the circular plan of the column; divide the circumference of this plan into 20 equal parts, and draw the flutes and fillets; then draw the moldings of the base and the plan of the plinth and pedestal.

Now profile the entasis of the column as shown in Fig. 5. Draw the center line $a' b'$ at a distance of $7\frac{7}{16}$ inches from the left-hand border line, and draw the base line $m' b'$ in line with that of the pedestal in Fig. 4. Draw the upper line $k' a'$ 11 m. above $m' b'$; make $k' a'$ equal to the semi-diameter of the shaft at the neck, which is 25 p. From $b'$ as a center, with a radius of 1 m., describe the arc $m' w'$. From $k'$ draw a line parallel to $a' b'$, intersecting the arc at $l'$; divide the arc $m' l'$ into 11 equal portions, as shown at $1$, $2$, $3$, etc.; divide the center line $a' b'$ into 11 equal portions, and draw horizontal lines $1_1 w'$, $2_1 v'$, etc.; from the point $1$ on the arc, draw a line parallel to $a' b'$; its intersection with the line $1_1 w'$ will give one of the required points. From $2$ draw a similar line to $2_1$, etc. All the points being marked, draw a curve through them by means of a spline, or flexible strip.

Draw the line of the shaft below the neck of the capital on Fig. 1, parallel to $k' 10_1$ of Fig. 5, which will give the taper of the shaft at that section; draw the taper of the opposite line by a measurement from the center line $a b$. Since the lower portion of the shaft is cylindrical, the lines representing this portion will be parallel to the center line $a b$. In order to draw the fluting of the lower portion of the shaft on Fig. 1, project the edges of the flutes on Fig. 4 down to the center line $g h$, by drawing a series of lines parallel to the center line $a'' b''$; then transfer their position on line $g h$ by means of a strip of paper on which the points have been punctured, carefully noting the position of the center line $a'' b''$.

To draw the fluting of the upper portion of the shaft, a different procedure will be necessary. From points $a'$, $n'$, and $o'$ on Fig. 5, with radii equal to the semi-diameter of the shaft at the section on which these points are located, describe quadrants; divide each arc into 5 equal spaces from the points marked on the arc, which will be the centers of the flutes; with a radius equal to two-fifths the length of the arc between the centers of the flutes, describe the semicircles defining the flutes; project the lines of the fillets between the flutes to their position on the horizontal lines $k'\,a'$, etc., by drawing lines parallel to the center line $a'\,b'$; through the three points established for the edge of each flute, draw a curved line by means of a spline. Transfer the position of the edges on the line $k'\,a'$ to $e\,f$ of Fig. 1, and draw the edges of the flutes on Fig. 1 parallel to those on Fig. 5.

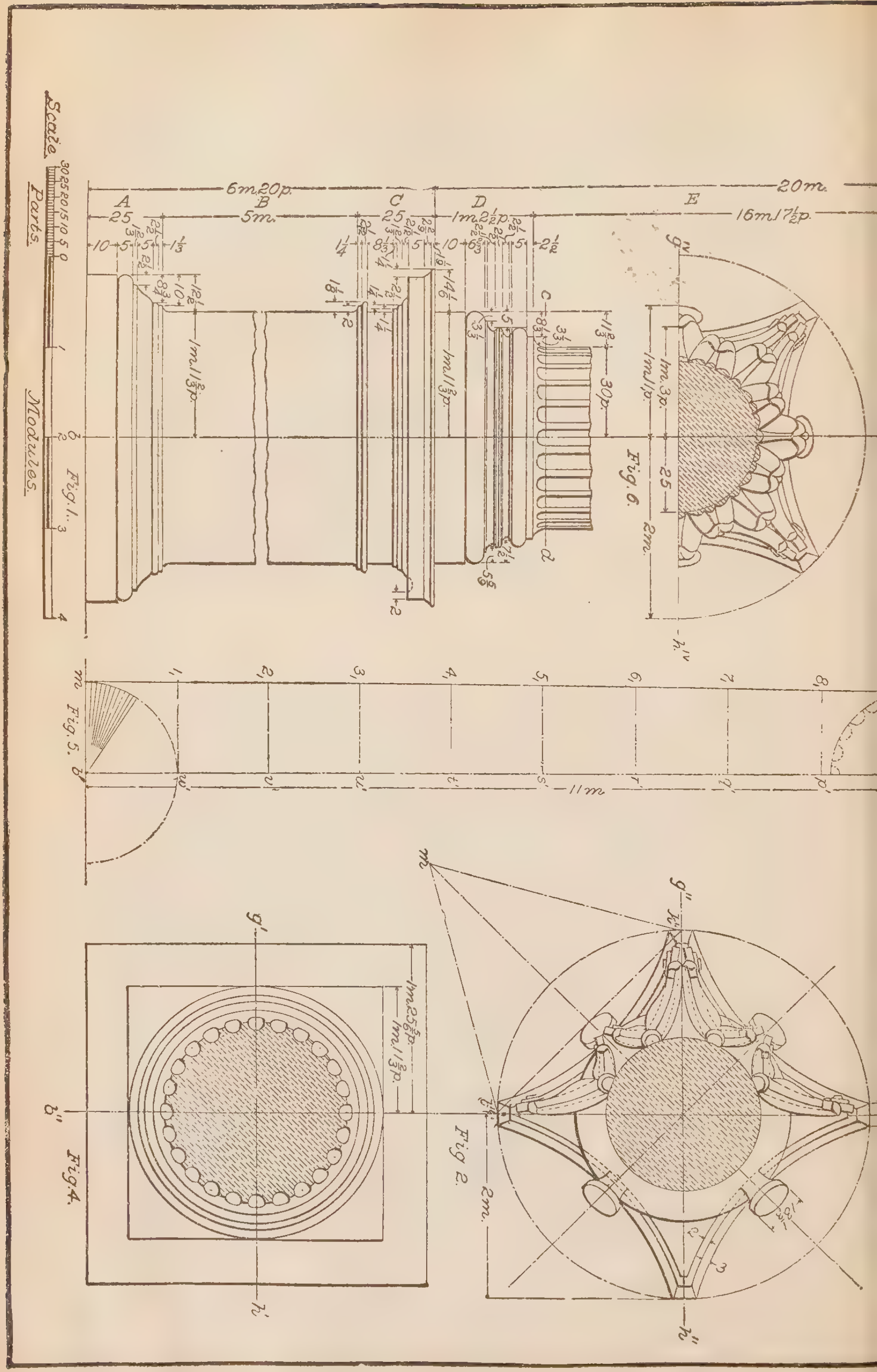
Now draw Fig. 2, the plan of the soffit of the entablature. Draw $a'''\,b'''$ $3\frac{5}{16}$ inches from the right-hand border line, and $g''\,h''$ $3\frac{13}{16}$ inches below the upper border line. The projection of the moldings may now be obtained from Fig. 1, and the lines drawn in Fig. 2. Complete the plate, putting in all dimensions, and cross-hatching all parts shown in section.

## DRAWING PLATE, TITLE: CORINTHIAN ORDER

**9.** The Roman-Corinthian order, Fig. 10 of the text, differs from its Greek prototype principally in the elaboration of its entablature and the arrangement of the foliage of its capital.

The diameter of the column in this plate being 14 inches, the module is 7 inches in length. From a point $1\frac{1}{2}$ inches from the left-hand border line, and $\frac{3}{8}$ inch above the lower border line, construct a scale 5 m. in length, as shown. Then commence Fig. 1 by drawing the center line $a\,b$ $4\frac{1}{8}$ inches from, and parallel to, the left-hand border; and from a point $\frac{3}{4}$ inch above the lower border lay off on $a\,b$ the measurements locating the horizontal divisions of the order, and draw lines defining these divisions. Profile the moldings of the pedestal, base, and entablature, according to the measurements on the plate, but omit the capital until the details of its foliage have been drawn.

Now draw Figs. 2 and 3, the plan of the under side and the angular elevation of the capital. Draw the center line $a''\,b''$



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# CORINTHIAN ORDER.

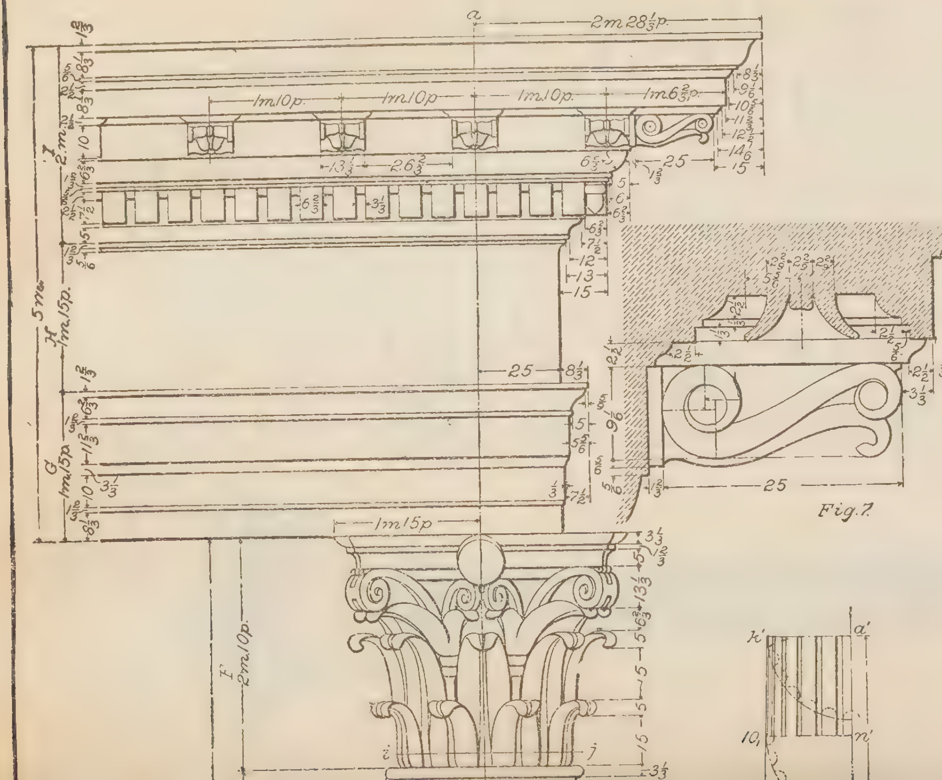


Fig. 7

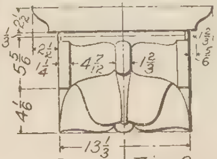


Fig. 8.

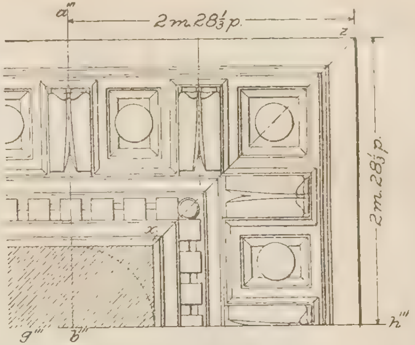
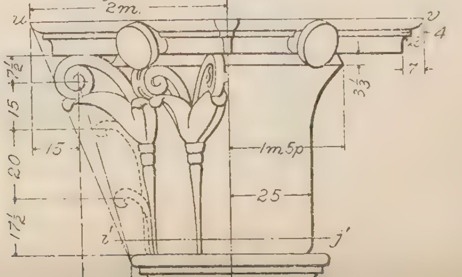


Fig. 9.



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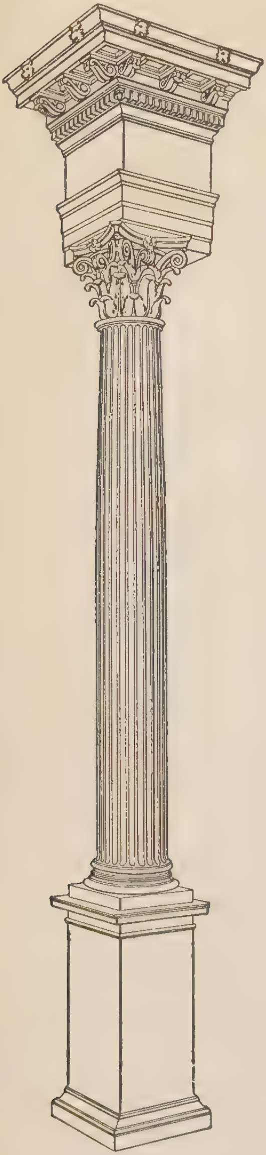

FIG. 10

$2\frac{3}{8}$ inches from, and parallel to, the right-hand border line, and draw $g'' h''$ $6\frac{3}{8}$ inches above the lower border line; with the point of intersection of $a'' b''$ and $g'' h''$ as a center, and with a radius of 25 p., draw a circle defining the outline of the bell as it would be on the section line $i j$ of Fig. 1. From the same center, but with a radius of 1 m. 5 p., describe a circle defining the projection of the bell at the top; and, with a radius of 2 m., draw a circle limiting the projection of the angles of the abacus. Draw $k'' l''$, and with this line as a base, construct the equilateral triangle $k'' m l''$; mark the width of the angles of the abacus, $3\frac{1}{2}$ p. each side of the axial lines as shown; and with $m$ as a center describe the arc defining the concave side of the abacus. Draw the other three sides in the same manner, and sketch in, freehand, the circular blocks, from which the ornaments would be cut on each side of the abacus. Divide the circumference of the column section into 8 equal parts, as shown, and locate a stem of the foliage in the center of each of these parts.

Now draw Fig. 3, locating $u v$, the upper line of the abacus, $11\frac{1}{4}$ inches above the lower border line. Draw the horizontal lines of the abacus, bell, and astragal, according to the measurements given, and locate the center of the eye of the small volute $7\frac{1}{2}$ p. below the abacus, and 20 p.

from the neck of the column; then draw the volute freehand. Points in the curves of the volute may now be projected to Fig. 2, and the volute may then be drawn in place.

Complete Fig. 2, drawing the plan of the cauliculi, cauls, and volutes, and the molding lines on the angles and concave sides. The right side of Fig. 3 is left plain, to show clearly the outline of the bell, but on the left side the foliage is shown in position, the center lines of the stems being projected from Fig. 2. The dotted outlines on the extreme left show the projection of the two tiers of leaves, which is limited by a line drawn from the eye of the volute to the edge of the astragal.

A half plan of the capital should now be drawn, as in Fig. 6, making the line $g^{iv} h^{v}$ a continuation of $g'' h''$. Draw the leaves in Fig. 6 as shown, obtaining their projection beyond the column line from the dotted outline in Fig. 3.

Now finish the capital in Fig. 1, projecting the lines of the abacus from Fig. 3, and profiling the moldings at the angles of the abacus, by projecting lines from Fig. 6. Draw in the leaves and cauliculi as shown, carefully drawing the curl at the tips of the leaves, according to the measurements given.

Now draw Fig. 4, the plan of the base and pedestal, locating $g' h'$ $2\frac{3}{8}$ inches above the lower border line. Draw the flutes of the column and moldings of the base, as described for the previous plate, and project the lines of the flutes to a strip of paper and transfer them to Fig. 1. Then draw the flutes in the lower part of the column in Fig. 1, and proceed to Fig. 5. The line $a' b'$ is located $5\frac{5}{8}$ inches from the right-hand border line, and is 11 m. in length. The arc $m w'$ is divided as shown, and the entasis of the column and flutes is described according to the method explained on the previous plate. Draw the flutes on the upper part of the column in Fig. 1, by marking them on a strip of paper and transferring them from Fig. 5; outline their finish, on the apophyge of the shaft, freehand.

Now draw Figs. 7 and 8. which are elevations of the side and front of one of the **modillions,** or brackets, under the corona of the cornice, drawn to three times the scale of Fig. 1.

These modillions are a very much modified form of the Doric mutule, but are more elaborate than their prototype, combining in one design the scroll or volute of the Ionic capital and the rich foliation of the Corinthian. The extreme projection of the modillion is $29\frac{1}{6}$ p., and its depth is $12\frac{1}{2}$ p. To proportion its details and locate centers for curves of the volutes, make $a b$, Fig. 11 of the text, equal to 30 p., the extreme projection of the corona, and divide it into 10 equal parts; then make $a c$ equal to 9 of these parts. Make $d c$, the depth of the large volute, equal to $\frac{1}{3}$ of $a c$, and draw $f h$ through $c$ and parallel to $a b$. Make $f g$ equal to $\frac{1}{6}$ $d c$, and divide $d e$ into 14 equal parts. Then make $g h$ equal to 36 of these parts, and draw $h n'$. The center $o$ of the eye of the large volute is at the intersection of a vertical line drawn from the seventh of these parts and a horizontal line drawn from the sixth subdivision of $d c$, while the diameter of the eye is equal to 6 parts, as from $3$ to $9$. In the smaller volute, the center $o'$ of the eye is at the intersection of a vertical and horizontal line drawn from $34''$ and $5$, respectively, and the diameter of the eye is 4 parts, as from $3$ to $7$ on $d e$. To find the centers of the arcs of the volute, describe a circle on $o$ as a center, and with a radius equal to 1 part of subdivision of $d e$, within which draw a diagonal square as shown. The points $1$, $2$, $3$, and $4$, at the middle of the sides of this square, are the centers from which the arcs $1_1$–$2_1$, $2_1$–$3_1$, $3_1$–$4_1$, and $4_1$–$5_1$ are drawn, while points $5$ and $6$, located half way between $o\,1$ and $o\,2$, are the centers from which the last two arcs of the spiral are drawn. The width of the fillet at $q$ is one-third of the distance from $1_1$ to $p$, and diminishes to the width at $6_1$–$6_2$, where the inner volute becomes tangent to the eye. Lay off $1_2\,q$ equal to $6_1$–$6_2$, and divide $q\,1_1$ into 5 equal parts; then make the width of the fillet at $2$–$2_2$ equal to the width at $1_2$–$1$, diminished by one of these parts, and the width of the fillet at $3$–$3_2$ equal to the width at $1_2$–$1$, diminished by two parts, and so on to the point $6_2$, where the fillet becomes tangent.

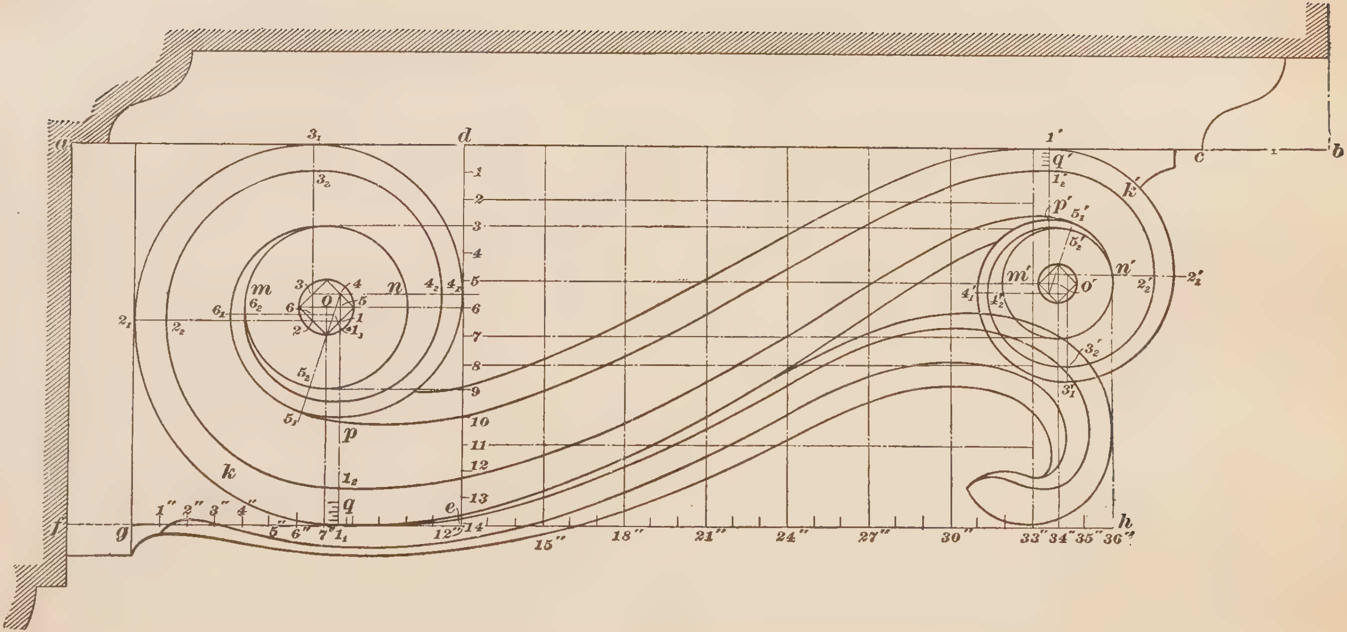
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FIG. 11

The smaller volute is drawn in precisely the same manner, except that it is inverted; and, the eye being slightly larger in proportion to the extreme diameter of the volute, but five arcs are required for the spirals. The lines connecting the curves of the two volutes, and the outline of the curled leaf under the volutes, should be drawn freehand, with the aid of the system of squares, drawn as shown in Fig. 11 of the text.

Now draw the modillion on the plate, as shown in Fig. 7, locating the soffit line of the corona 4 inches below the upper border line, and the front of the corona $4\frac{3}{4}$ inches from the right-hand border line. Locate the center line of Fig. 8 at a distance of $3\frac{3}{4}$ inches from the right-hand border line, and draw the end elevation of the modillion from the measurements given, and with lines projected from Fig. 7.

Now draw the modillions in the cornice and complete Fig. 1; then draw Fig. 9 from the measurements given in Fig. 1, locating the axial lines $a''' b'''$ and $g''' h'''$ $3\frac{1}{4}$ inches and $3\frac{7}{8}$ inches from the right and upper border lines, respectively. Draw the entasis of the column and flutes as shown in Fig. 5, according to explanation for previous plates, locating the line $a' b'$ $5\frac{1}{8}$ inches from the right-hand border line.

## DRAWING PLATE, TITLE: COMPOSITE ORDER

**10.** The Composite order was invented by the Romans in the endeavor to secure something more elaborate than the Corinthian. It is practically a combination of the Ionic and Corinthian, with proportions nearly identical with the latter, as shown in Fig. 12 of the text.

The diameter of the column in this plate is 14 inches, the same as in the previous order, and the module is consequently the same, i. e., 7 inches in length.

Construct a scale of modules $\frac{1}{4}$ inch above the lower border line, and $2\frac{1}{8}$ inches from the left-hand border line. Draw $a b$, the center line of Fig. 1, 4 inches from the left-hand border line; and from a point $\frac{3}{4}$ inch above the lower border, lay off on $a b$ a series of measurements, locating the horizontal divisions of the order, and draw the lines defining these divisions. Profile the moldings of the pedestal, base, and entablature, according to the measurements given. Draw the dentils in the cornice, and complete the figure, except the capital of the column and the fluting of the shaft.

Now draw Figs. 2 and 3, the plan of the under side and the angular elevation of the capital. Draw the center line $a'' b''$ $2\frac{3}{8}$ inches from the right-hand border line, and draw $g'' h''$ $6\frac{3}{8}$ inches above the lower border line. With the point of intersection of $a'' b''$ and $g'' h''$ as a center, and with a radius of 25 p., draw the circular outline of the bell; and, with a radius of 1 m. 3 p., draw the outline of the echinus at the top of the bell. Then draw the moldings under the echinus and the circle limiting the projection of the angles of the abacus. Draw the concave sides of the abacus according to the method described for the previous plate; locate the blocks in the center of the sides, and complete the figure, except the volutes, which must first be drawn in Fig. 3.

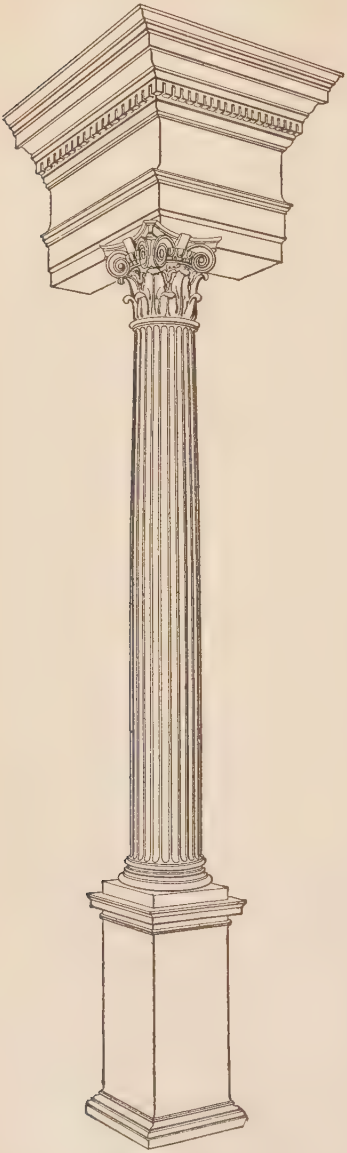
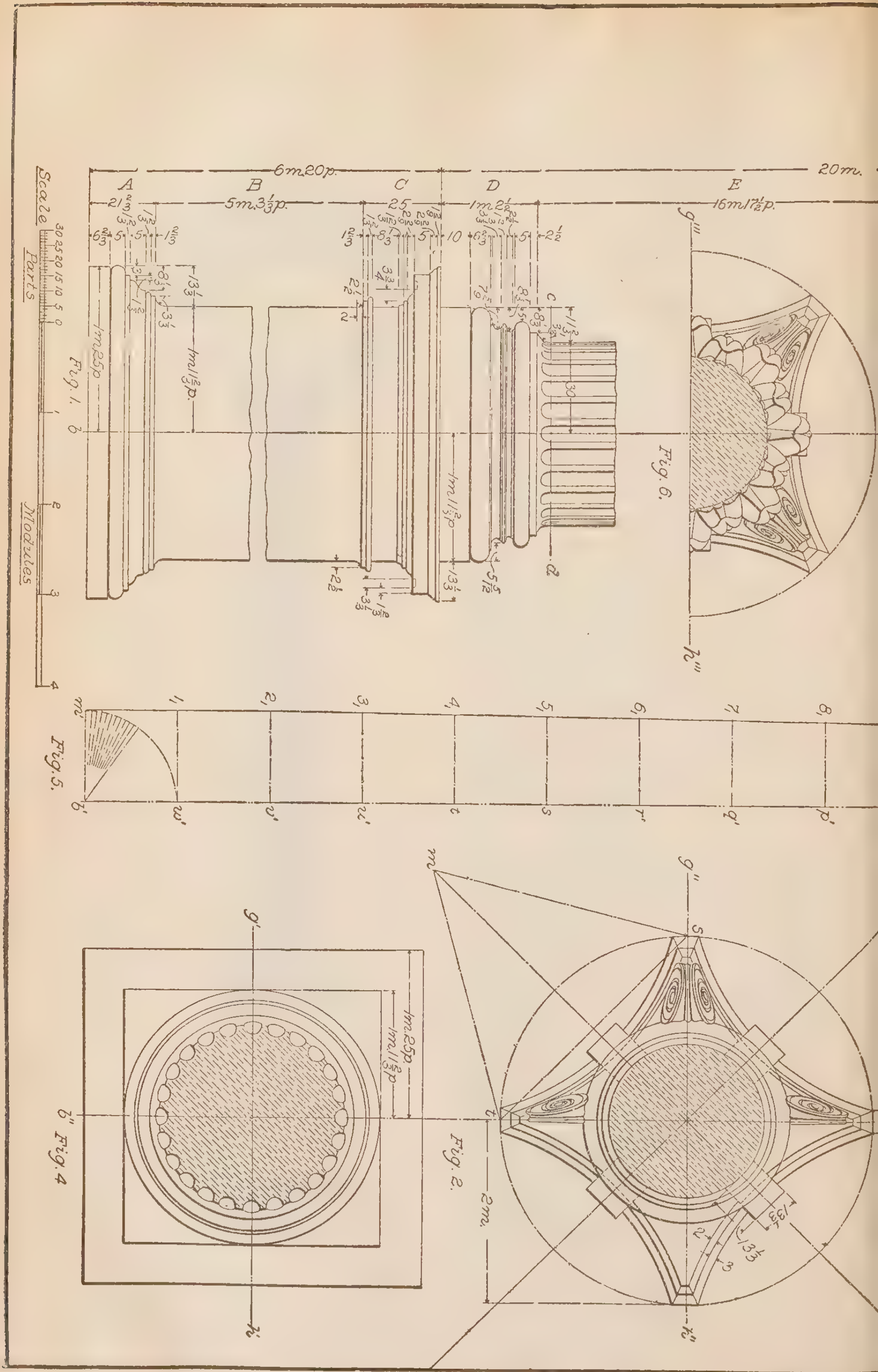


Fig. 12

Draw $u v$, the upper line of the abacus in Fig. 3, at a



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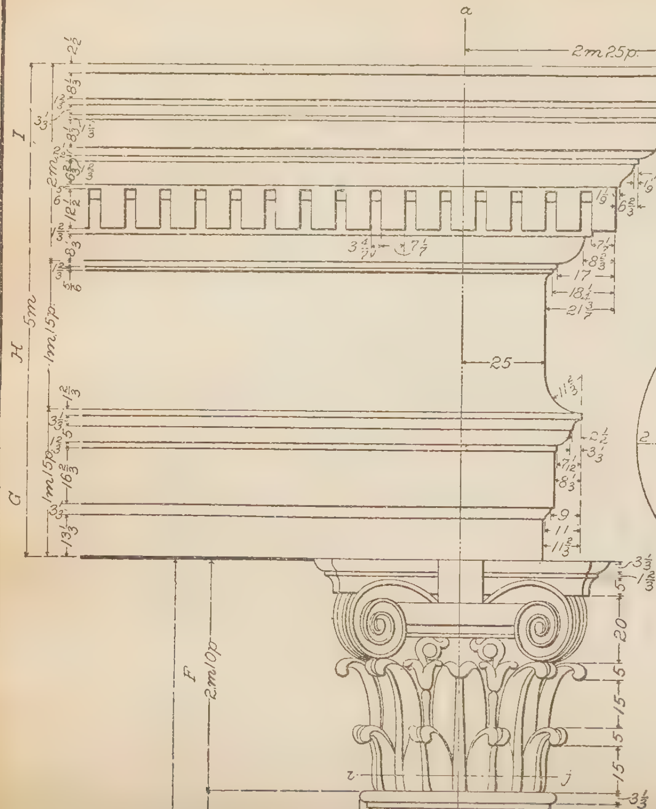
# COMPOSITE ORDER.



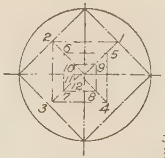


Fig. 8.

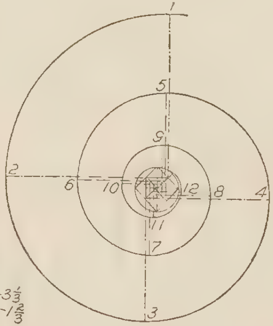
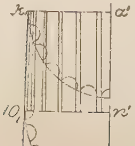


Fig. 7.



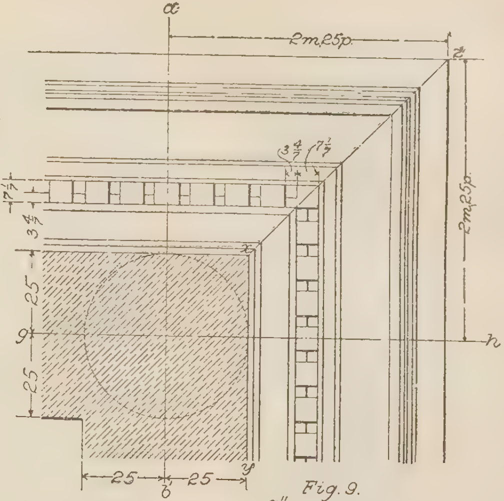
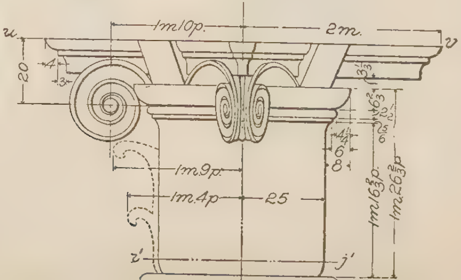


Fig. 9.



distance of 11¼ inches above the lower border line. Lay off the measurements locating the horizontal divisions, and draw the lines defining these divisions. Profile the moldings of the abacus, bell, and astragal, and locate the center of the eye of the volute according to the measurements given. With a radius of 1¾ p., describe a circle as the eye of the volute. The eye must then be divided as shown in Fig. 8, and the arcs of the spiral may be described as shown in Fig. 7, according to the method explained for the drawing of the volutes in the Ionic order. Now complete the volute on the left-hand side of Fig. 3, and project the principal points of its curves to the plan, Fig. 2. Draw the plan of the volutes in Fig. 2, and project the principal points of the curves in plan to intersect with lines drawn from similar points in Fig. 3, and through these points of intersection draw the elevation of the volutes on the center line of Fig. 3.

Now complete Figs. 2 and 3 entirely, and draw the capital in Fig. 1. The plan of the capital, Fig. 6, may be traced and transferred from Fig. 2, the leaves being drawn in, according to the projections figured for them in Fig. 3. Complete Fig. 6, and project the details to the capital in Fig. 1. Then draw the plan of the base, Fig. 4, locating $g' h'$ 2$\frac{5}{16}$ inches above the lower border, and draw the entasis of the shaft and flutes as shown in Fig. 5, according to the description given for the previous plate, locating $a' b'$ 5⅜ inches from the right-hand border line. Now complete Fig. 1, drawing the flutes from Figs. 4 and 5. Then draw Fig. 9, locating $a' b'$ 3¼ inches from the right border line, and $g h$ 3⅞ inches from the upper border line. Complete the plate with all dimensions and dimension lines.

## DRAWING PLATE, TITLE: IONIC DETAILS

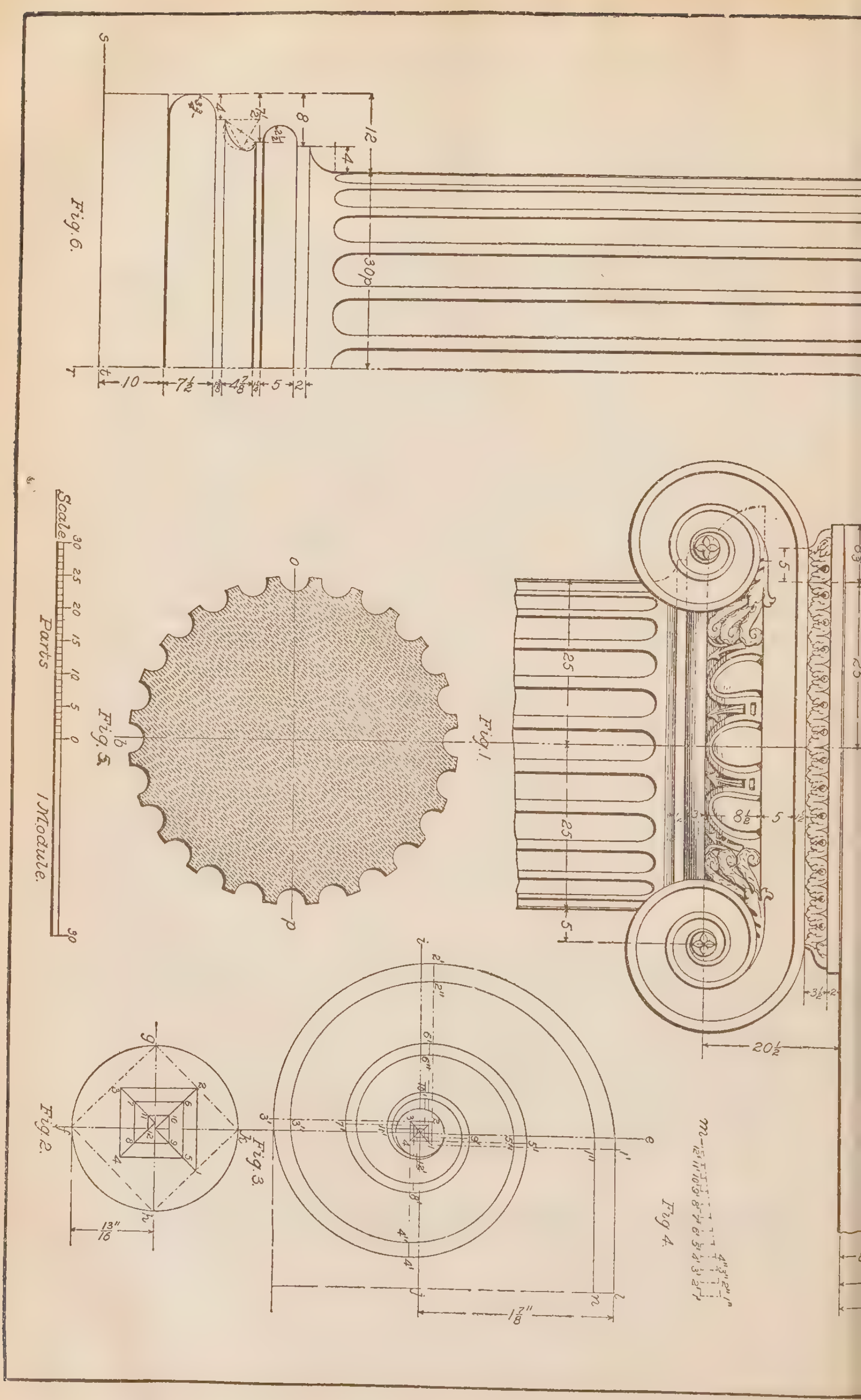
**11.** This plate shows several details of the Roman-Ionic order, drawn to a scale of 1⅞ inches = 1 module. Draw the lower line of the scale at a distance of ⅜ inch above the lower border line; mark a point 5$\frac{1}{16}$ inches from the left-hand border line; from this point mark the lower diameter of the column, which is $3\frac{3}{4}$ inches; divide this measurement into 2 equal parts, then subdivide the first division into 30 equal parts, as shown.

Proceed with Fig. 1, which is an *elevation of the column, capital, and entablature;* begin by drawing the center line *a b* at a distance of $6\frac{7}{8}$ inches from, and parallel to, the left-hand border line; draw *c d*, the top line of the cornice, at a distance of $\frac{11}{16}$ inch below the upper border line. From the line *c d*, mark a series of points on the center line *a b*, defining the principal divisions of the entablature thus: 1 m. 20 p. for the cornice; 1 m. 15 p. for the frieze; and 1 m. 10 p. for the architrave. Subdivide the architrave into three facias and a cymatium, the last named consisting of a cyma reversa and a fillet; subdivide the cornice into two equal divisions, the lower division being the bed mold, and the upper one the corona; subdivide the bed mold of the cornice into three divisions, measuring 6 p. for the cyma reversa, $10\frac{1}{2}$ p. for the dentil course, and $8\frac{1}{2}$ p. for the crowning members; subdivide the corona into three divisions, measuring 10 p. for the facia, $4\frac{1}{2}$ p. for the cymatium, and $10\frac{1}{2}$ p. for the cyma recta and fillet of the crowning member.

At a distance of 25 p. to the left of center line *a b*, draw the line of the return of the entablature; then profile the members of the architrave and cornice in accordance with the measurements given, drawing the curves with the bow-pencil.

Locate and draw the dentils in the dentil course in accordance with the measurements given. Draw the horizontal lines defining the members composing the capital; profile the *abacus*, which projects $8\frac{2}{3}$ p. beyond the line of the shaft (which is also the line of the architrave); mark the centers of the eyes of the volutes, which are located at the intersections of the lower line of the echinus, with lines drawn at a distance of 30 p. from, and parallel to, *a b*, the center line of the column.

Within the eye, establish the centers and carefully draw each volute. The dotted lines on the face of the left-hand



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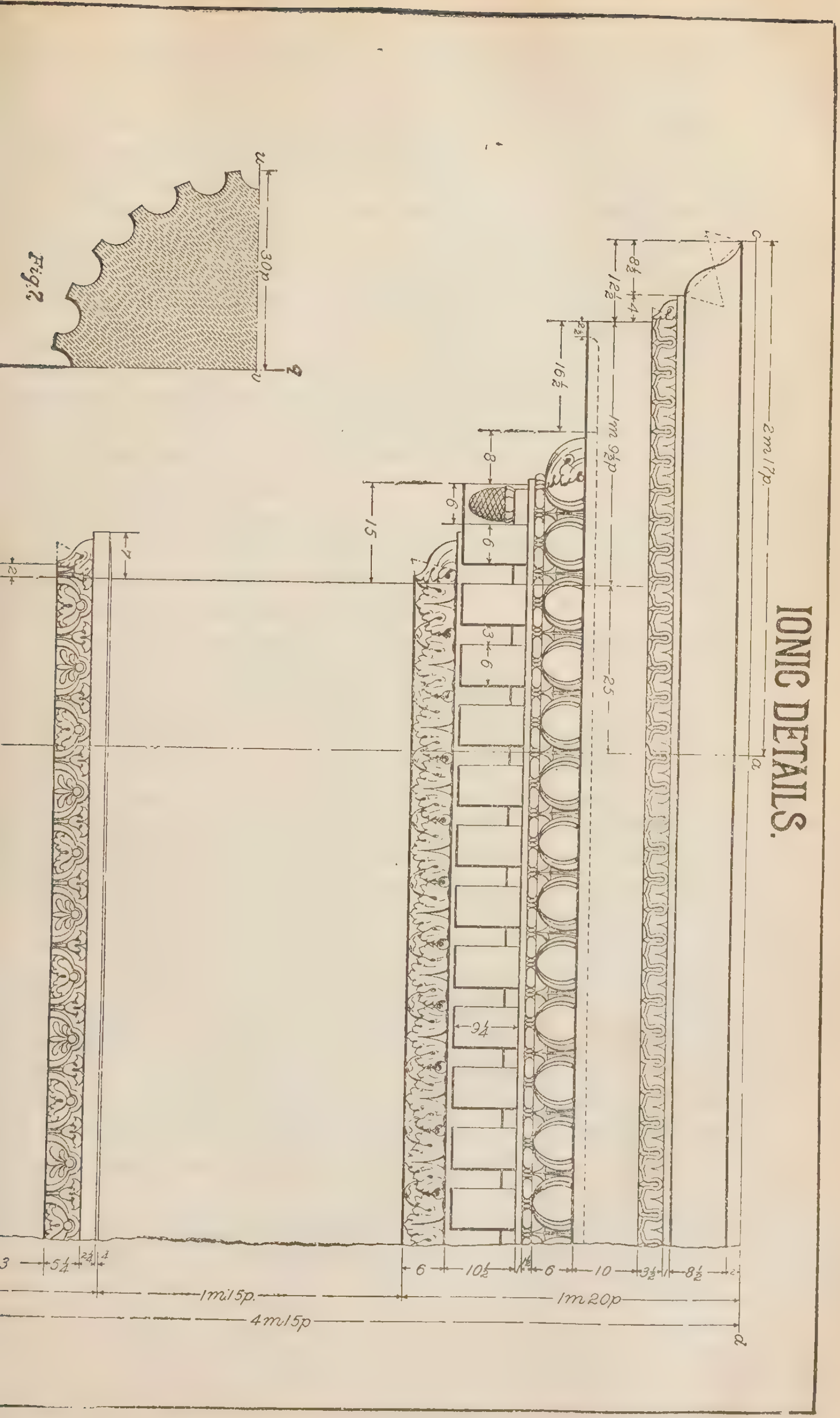

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volute indicate the profile of the neck of the shaft of the column and the members of the capital.

Before drawing the flutes of the shaft, it will be necessary to draw Fig. 5, the *plan of the shaft* at the commencement of the apophyge; draw the line $op$ at a distance of $2\frac{1}{16}$ inches above the lower border line; then, from the point of intersection of the line just drawn with the center line $a\,b$, with a radius of 25 p., describe a circle. As the surface of the shaft is channeled into 24 flutes, each quadrant of the circle defining its plan will have 6 flutes, and, as the angle at the center of each quadrant is 90°, the angle contained between the radial lines that pass through the center of each flute will be one-sixth of this, or 15°.

Divide the quadrant into 6 equal parts; then, from the points where the radial lines intersect with the arc, with a radius equal to two-fifths of the length of the arc between the radial lines, describe the flutes.

After the flutes have been drawn, the lines of the fillets between them can be projected up to Fig. 1. The curved stops of the flutes may be drawn freehand.

Draw Fig. 6, which is an *elevation of the plinth, base, and lower end of the shaft.* Commence by drawing the center line $q\,r$ at a distance of $3\frac{3}{8}$ inches from, and parallel to, the left-hand border line; draw $s\,t$, the bed line of the plinth, at a distance of $\frac{3}{4}$ inch above the lower border line. On the line $q\,r$, commencing at the point $t$, lay off a series of measurements for its subdivisions; thus, 10 p. for the plinth, $7\frac{1}{2}$ p. for the lower torus, $1\frac{3}{8}$ p. for the fillet under the scotia, $4\frac{7}{8}$ p. for the scotia, $1\frac{1}{4}$ p. for the fillet over the scotia, 5 p. for the upper torus, 2 p. for the upper fillet, and 4 p. for the apophyge. At a distance of 30 p. to the left of the center line $q\,r$, draw the outer line of the shaft, and at a farther distance of 12 p. draw the return line of the plinth; locate and draw the fillet lines, and with the bow-pencil draw the upper and lower torus moldings with their respective radii.

In order to draw the scotia, which is a compound curve, first draw a line joining the corners of the fillets; on this line as a base describe a semicircle; then, from the corner of the lower fillet, draw a line at an inclination of 30° from the horizontal; the line will intersect with the semicircle at the point shown; on this line erect an equilateral triangle; from its apex, with a radius equal to one of its sides, describe the lower portion of the curve; then, with a center at the point where the line of the upper fillet extended intersects the upper side of the triangle, describe the upper portion of the curve.

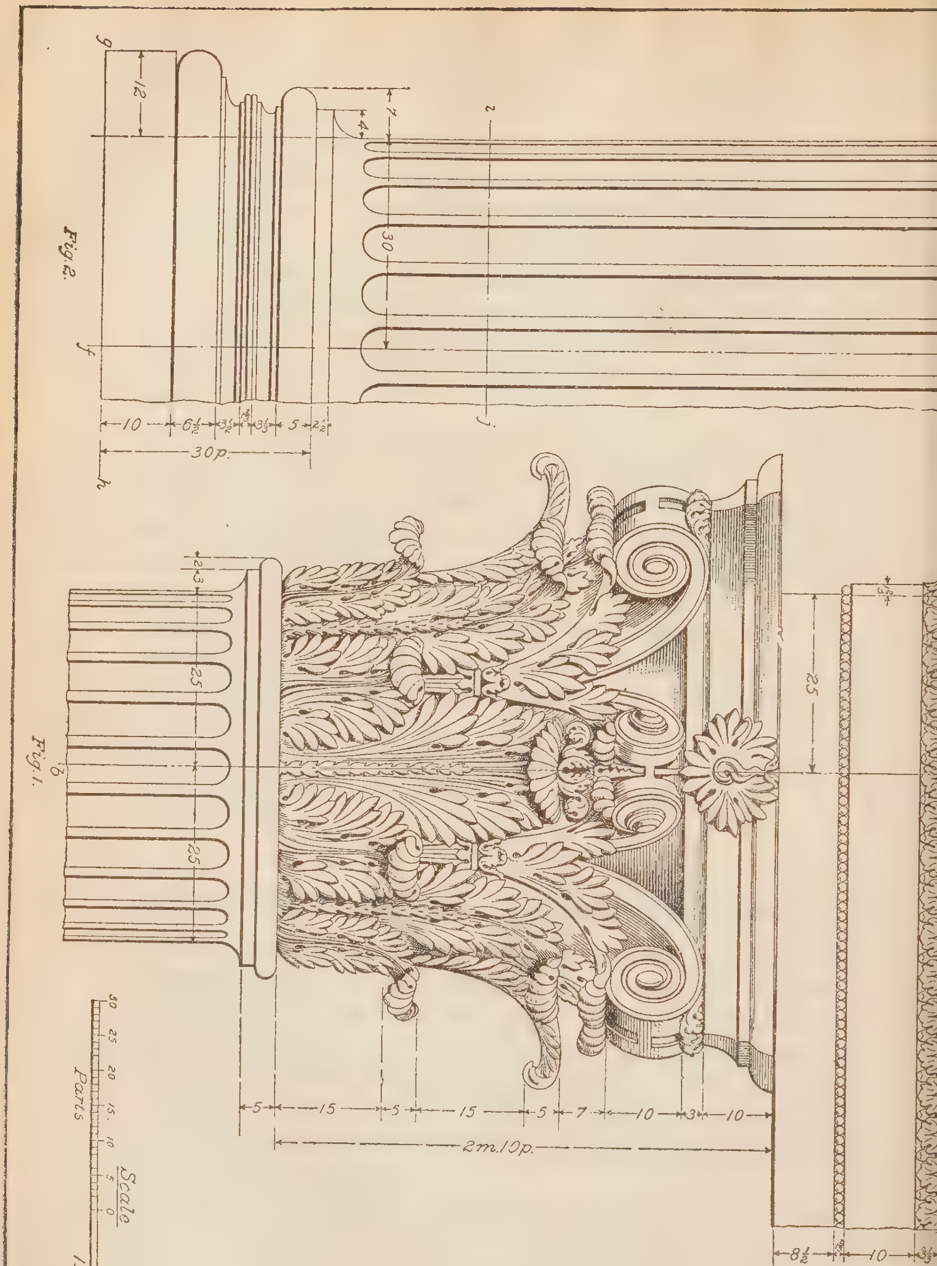
Draw Fig. 7, a *quarter plan of the shaft*, locating the axial line $u\ v$ at a distance of $11\frac{5}{8}$ inches above the lower border line; from $v$ as a center, with a radius of 30 p., describe a quadrant; then subdivide the arc and draw the flutes by the method given for Fig. 5, and project the fillet lines down to Fig. 6.

Locate the center lines of the ornaments with which the molded members of the cornice are enriched, by means of scale measurements from the plate. Carefully draw in a section of each ornament, then trace and transfer to the adjacent sections. Draw the egg-and-dart enrichment cut in the echinus of the capital.

## DRAWING PLATE, TITLE: CORINTHIAN DETAILS

**12.** This plate shows a study of several details of the Roman-Corinthian order, drawn to a scale of $1\frac{7}{8}$ inches = 1 module. Draw this scale, at a distance of $\frac{3}{4}$ inch above the lower border line; mark a point $4\frac{1}{8}$ inches from the right-hand border line; from this point mark the lower diameter of the column, which is $3\frac{3}{4}$ inches; divide this measurement into 2 equal parts, then subdivide the first division into 30 parts.

Proceed with Fig. 1, which is an *elevation of the shaft, capital, and entablature.* Draw the center line $a\ b$ $6\frac{3}{4}$ inches from, and parallel to, the left-hand border line; draw $c\ d$, the top line of the cornice, $\frac{7}{8}$ inch below the upper border line. From the line $c\ d$, mark a series of points on the



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# CORINTHIAN DETAILS.

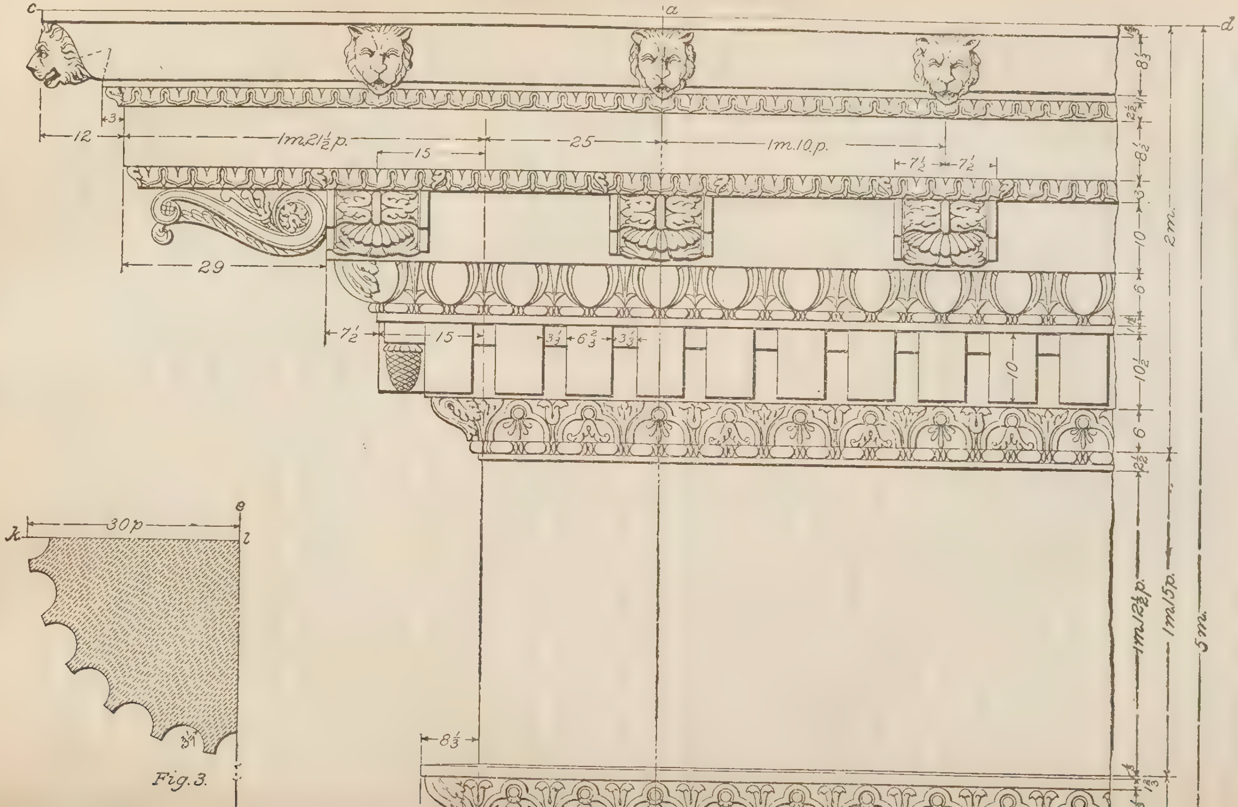


Fig.3.

center line *a b*, defining the principal divisions of the entablature, giving 2 m. for the cornice; 1 m. 15 p. for the frieze, of which $2\frac{1}{2}$ p. belong to the cymatium of the frieze; and 1 m. 15 p. for the architrave. Subdivide the architrave into facias and molded bands, and subdivide the cornice into its respective parts by horizontal lines, as shown.

At a distance of 25 p. to the left of the center line *a b*, draw the line of the return of the entablature, and profile the members of the architrave, frieze, and cornice, in accordance with the measurements given, drawing the curves with the bow-pencil. Locate and draw the dentils in the dentil course, as shown. Lay off the height of the capital, which is 2 m. and 10 p., and under the capital draw the astragal and fillet, defining the collar of the shaft.

Draw Fig. 2, which is a *half elevation of the base of the column and lower end of the shaft;* draw the center line *e f* at a distance of 3 inches from the left-hand border line, and draw *g h*, the bed line of the plinth, at a distance of $\frac{3}{4}$ inch above the lower border line. From the line *g h*, lay off a series of measurements defining the members of the base, as shown, and draw the horizontal lines. At a distance of 30 p. to the left of the center line *e f*, draw the outer line of the shaft, and profile the base, drawing the upper and lower torus moldings by means of the bow-pencil.

In order to draw the fluting at the lower end of the shaft, it will be necessary to draw Fig. 3, which is a *quarter plan of the shaft* on the line *i j*; draw *k l*, the axial line of the shaft, at a distance of $11\frac{1}{2}$ inches above the lower border line, and from *l* as a center, with a radius of 30 p., describe a quadrant. Locate the centers for the flutes in accordance with the instructions given for previous plates, and project the fillet lines down to Fig. 2. The position of the flutes at the neck of the shaft of Fig. 1 can be determined by drawing from the center *l* of Fig. 3 a quadrant having a radius of 25 p., on which the fillet lines can be determined, thence projected to the line *k l*, and transferred to Fig. 1.

Commence the decorative features by locating the center lines of the modillions from the measurements given, and draw the lines defining their width. Observe that the ornament on the various members of the cornice is regularly disposed, of which the center lines of the modillions may be taken as the regulators. Sketch one of them carefully, and then trace it and transfer to the other position. The lion heads, although now used in this position only as a decorative feature, were originally disposed as a series of waterspouts, the water from the roof being discharged through the open mouth.

Sketch in a section of the leaf ornament on the cymatium of the corona, between the center lines of the modillions, and also on the cymatium of the modillions and modillion band, and transfer to the adjacent sections. Observe that there is a leaf on the external angles of the modillions; a similar leaf is usually placed at the internal angles, so as to make a neater effect where the miter lines occur. Those on the internal angles are omitted, in order to prevent confusion on the elevation. Draw the egg-and-dart ornament on the echinus under the modillion band, and also the pearl-and-bead ornament under the echinus. Locate and draw the dentils in the dentil course, and sketch in the pendant in the angle, which is a conventionalized form of the pineapple.

Sketch in the side view of the modillion. The eye of the large volute is decorated with a leaf ornament, and the spandrel is occupied by a spray, growing out from the eye, and from which sprouts a group of petals; or the lower face of each modillion is decorated with an acanthus leaf similar to those on the capital.

Having drawn and completed the side view of the modillion, draw the molded outlines at the ends of the modillions, and sketch in the foliation on same. Draw the geometric element in the ornament over the frieze and on the cymatium of the architrave; this element is trefoil in form, and can be drawn by means of the bow-pencil; then fill in the spandrels and panels with the foliated and flower ornament. Sketch in the leaf ornament, and draw the beads on the enriched moldings between the facias of the architrave.

Draw the foliage of the capital of the column, first outlining the block form of the acanthus leaves, as was done on the drawing plate entitled, Corinthian Order; then subdivide into lobes and serrate the edges, as shown, and complete the plate.

### DRAWING PLATE, TITLE: COMPOSITE DETAILS

**13.** This plate shows several details of the composite order, drawn to a scale of $1\frac{5}{8}$ inches = 1 module.

Draw this scale as shown, the lower line being $3\frac{3}{8}$ inches above the lower border line; mark a point $3\frac{1}{2}$ inches from the right-hand border line; from this point mark a distance equal to the lower diameter of the column, which is $3\frac{1}{4}$ inches; divide this measurement into 2 equal parts, and subdivide the first one into 30 equal parts, as shown.

Begin Fig. 1, an *elevation of the capital of the column and the entablature*, by drawing the center line *a b* at a distance of $7\frac{7}{16}$ inches from, and parallel to, the left-hand border line; draw *c d*, the top line of the cornice, at a distance of $\frac{13}{16}$ inch below the upper border line.

From the line *c d* mark a series of points on the center line *a b*, defining the principal divisions of the entablature, giving 2 m. for the cornice, 1 m. 15 p. for the frieze, and 1 m. 15 p. for the architrave. Subdivide the architrave into three parts, two of which are facias, and the third one a group of moldings crowning the architrave, the lower facia being $14\frac{1}{3}$ p., and the upper one $16\frac{2}{3}$ p., as shown. The facias are separated by a cyma reversa $3\frac{1}{3}$ p. wide, while the cymatium is composed of a bead of $1\frac{2}{3}$ p. and echinus 5 p., a cavetto $3\frac{1}{3}$ p. and a fillet $1\frac{2}{3}$ p. in width; subdivide the cornice into bed-mold, dentil-course, facia, and crowning members, in accordance with the measurements given.

At a distance of 25 p. to the left of the center line *a b*, draw the line of the return of the architrave and frieze, and profile the molded members of the entablature, first locating the limits of their projections. Draw the curves by means of the bow-pencil.

Locate and draw the dentils in the dentil course, as shown. Draw the horizontal lines defining the members comprising the capital, the total height of which is 2 m. and 10 p.

Commence Fig. 2, a *half plan of the capital*, on line *e f*, looking upwards. Draw the line *g h* at a distance of $\frac{1}{2}$ inch above the lower border line; with a center on the point *b*, where the line *g h* intersects with the vertical center line *a b*, as a center, and with a radius of 2 m., describe a semicircle; then, from the center *b*, draw the diagonal lines *b i* and *b j*, each being at an angle of 45° from the line *g h*; through the points *i* and *j*, where the diagonal lines intersect with the semicircle, draw lines tangent to the semicircle; the width of the *nose*, or blunt end, being 8 p., lay off 4 p. on each side of diagonal lines, and mark the points *k*, *l*.

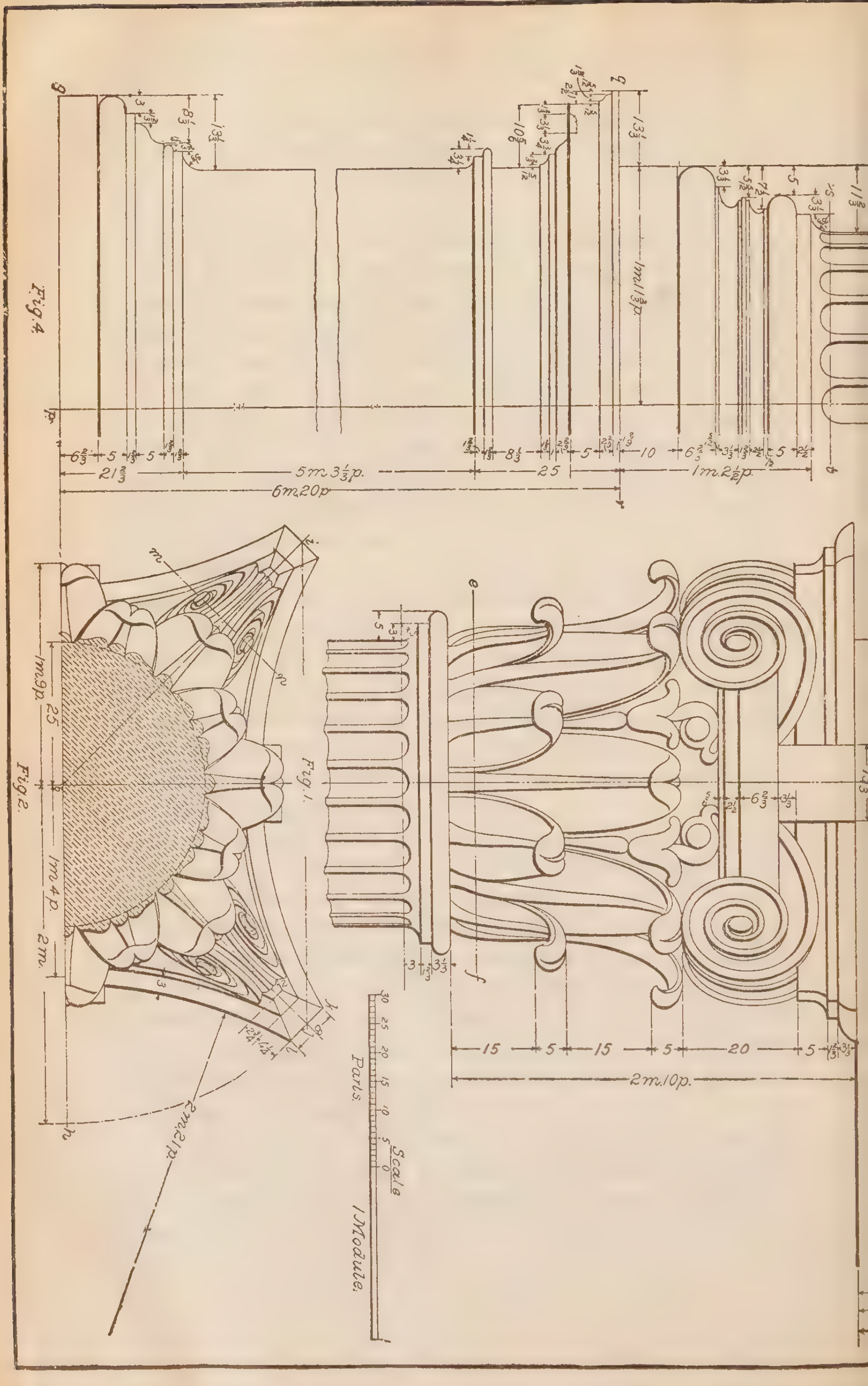
From the points *i* and *j*, with a radius equal to the horizontal distance between these points, strike two arcs which will intersect, above the plan, on the center line *a b*; and from the same points, with the same radius, describe arcs which will intersect on the line *g h* extended; from these points of intersection as centers, draw the curved lines, which should pass through the points *k* and *l*.

These curved lines define the concave sides of the abacus, the radius being about 2 m. and 21 p.

Lay off the widths of the molded members on the edges of the abacus in accordance with the measurements given, and draw the parallel curves as shown.

From the center *b*, with a radius of 25 p., describe a semicircle, which will represent the semi-diameter of the shaft of the column at the neck. Then, from the same center, with a radius of 1 m. and 9 p., describe a semicircle, which will give the projection of the large leaves; and with a radius of 1 m. and 4 p. describe a semicircle, which will give the projection of the small leaves.

Observe that the center lines of the large leaves are *a b*, *g h*, *b i*, and *b j*; in order to locate the center lines of the small leaves, bisect the angles contained between the center lines of the large leaves; sketch in one of the large and one



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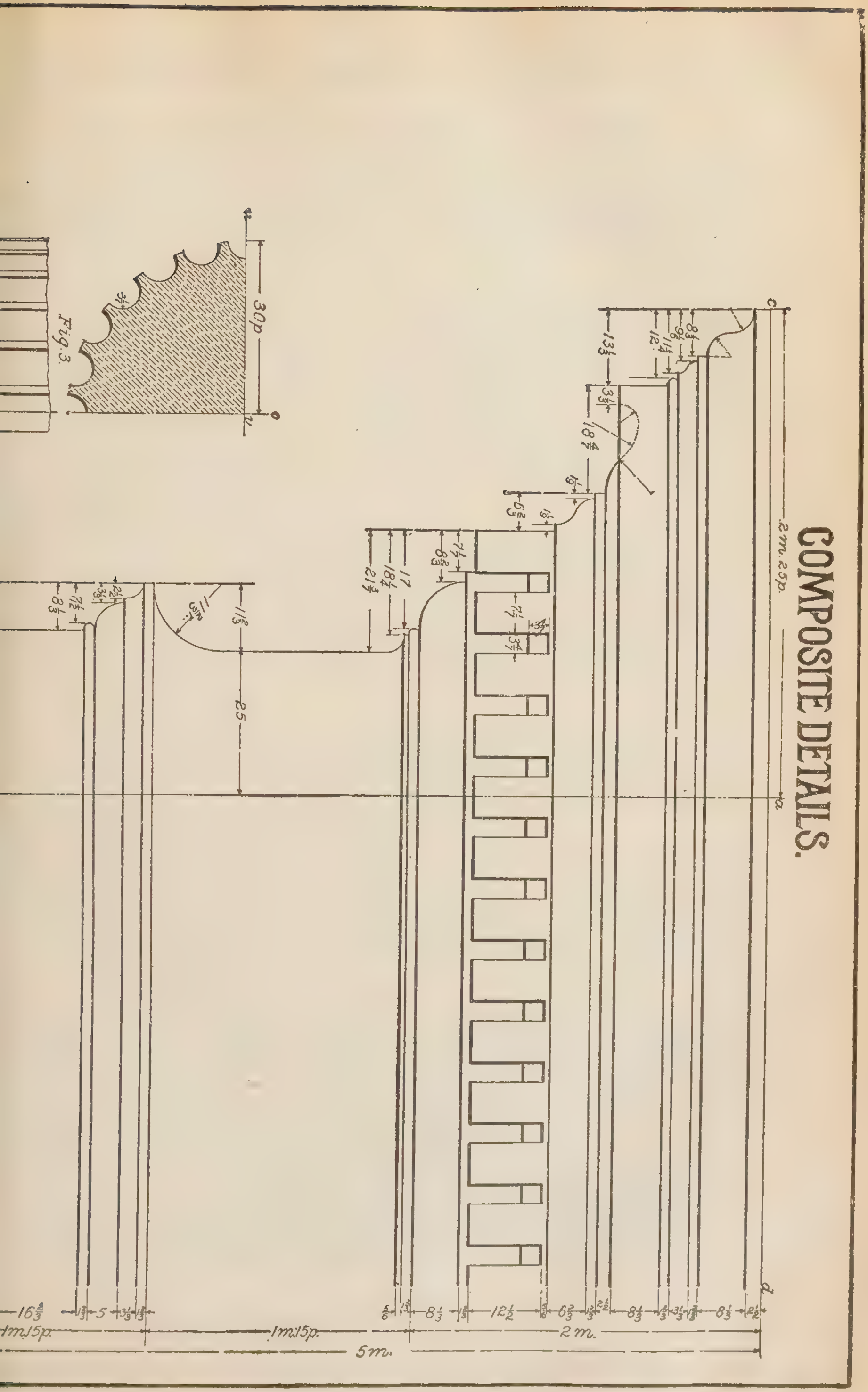

# COMPOSITE DETAILS.

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of the small leaves carefully, then make a tracing of the same and transfer to the other positions.

At a distance of 1 m. and 10 p. from the center $b$, mark points on the lines $b i$ and $b j$, and erect lines perpendicular to them, as at $m n$, which will locate the centers of the eyes of the volutes.

Sketch in one of the volutes, first locating the principal points by means of scale measurements taken from the plate; then trace and transfer to the opposite side. Project up the lines of the abacus and the principal points of the volutes to Fig. 1, observing that the center of the eye of the volute is in line with the lower line of the *echinus*, and is shown to be $6\frac{2}{3}$ p. in height.

Locate the principal points of the volutes, and sketch in one of them. In order to keep the drawing clean, and as practice and skill are necessary to draw the volute satisfactorily, the student is advised to practice on a separate sheet, first transferring the dimensions from the drawing to the sheet, and then to make a tracing and transfer the volute to the drawing plate.

Draw the horizontal lines that limit the heights of the leaves; project up the main points from Fig. 2, and sketch in the leaves on one side of the capital, which may then be traced and transferred to the other side.

The leaves shown represent the block form only. In practice the leaves would be subdivided into lobes and the edges would be serrated as in the previous plate; but in this example the block form is adopted for the sake of clearness and simplicity.

Proceed with Fig. 4, a *half elevation of the pedestal and base of the column*. Draw the center line $o p$ at a distance of $3\frac{13}{16}$ inches from the left-hand border line, and mark a series of points above $g h$ defining the members that compose the pedestal and base of the column. As the whole height of the pedestal is not shown, it will be necessary to draw $q r$, the top line of the cornice, at a distance of $5\frac{13}{16}$ inches above the lower border line, and mark the distances of the upper members from the line $q r$ just drawn.

Having drawn the horizontal lines, draw the return line of the pedestal and the plinth under the base of the column, which is 1 m. $11\frac{2}{3}$ p. from the center line *op*; then profile the molded members, using the bow-pencil where practicable.

Before drawing the flutes it will be necessary to draw Fig. 3, a *quarter plan of the column* on line *st*; from the center *v*, with a radius of 30 p., describe a quadrant and divide it into 6 equal parts; then from the center *v* draw radial lines through the points marked, and from these points as centers, with a radius of $3\frac{1}{7}$ p., describe the curves that define the flutes (the width of the fillets between the flutes will be one-fourth the width of the flute); now project the fillet lines down to Fig. 4, and complete the figure.

In order to draw the fluting of the column at the neck, as shown in Fig. 1, make another quarter plan of the column with the diameter as it exists at the neck; thus, from the center *v*, on Fig. 3, with a radius of 25 p., which is equal to the semi-diameter of the column at the neck, draw a quadrant; the intersection of the radial lines previously drawn with the small quadrant will give the centers for the flutes. From the center *v* draw lines passing through the fillet lines of the large quadrant; their intersection with the small quadrant will give the reduced width of both fillets and flutes; project the fillet lines of the small quadrant up to the line *uv*, and transfer the points by means of a strip of paper to Fig. 1, observing carefully that the center line *op* of Fig. 3 coincides with the center line *ab* of Fig. 1; draw the curved stops of the flutes freehand, and complete the figure.

## DRAWING PLATE, TITLE: DORIC DOORWAY

**14.** This plate shows a plan, elevation, and vertical section of a stone doorway designed in the Roman-Doric order, and adapted to meet the requirements of modern work. The figures in this plate are all drawn to a scale of $\frac{3}{4}$ inch = 1 foot, and should be carried along together, so that details of one may be projected to another.

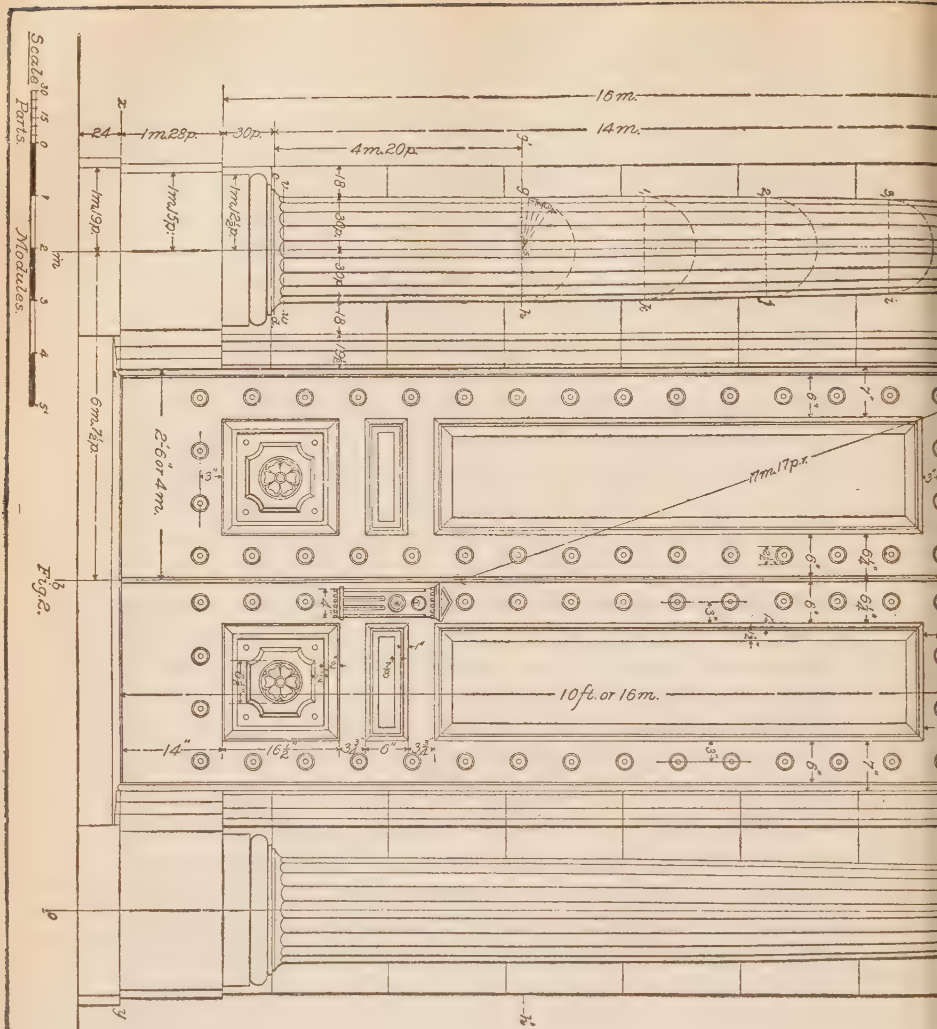

Fig. 2.

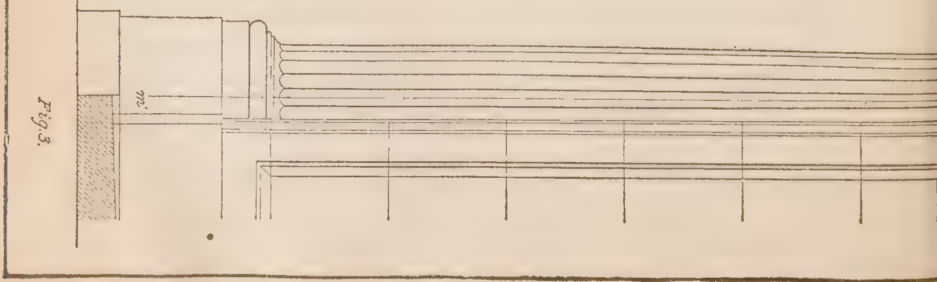

Fig. 3.

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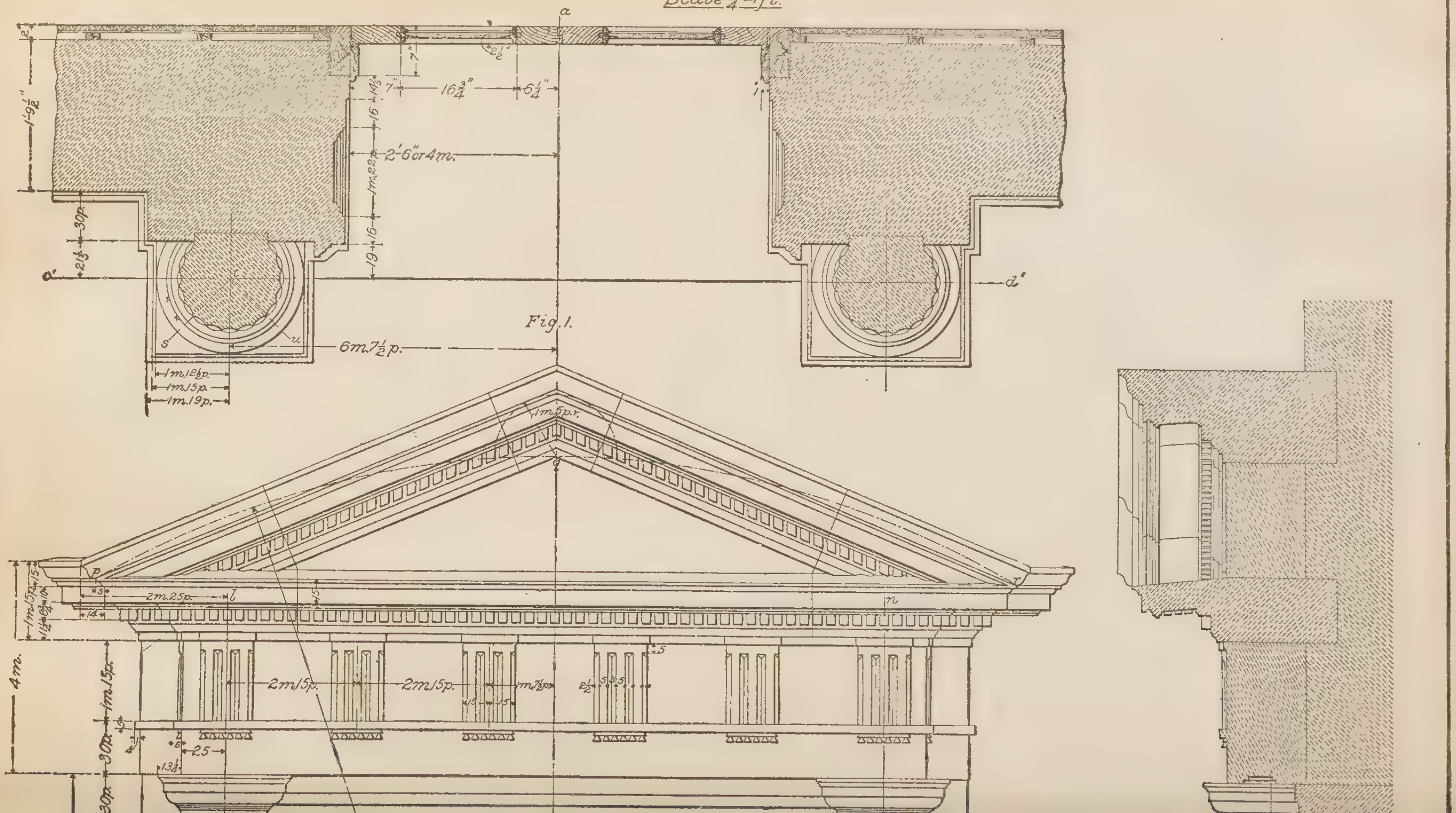
# DORIC DOORWAY.

Scale $\frac{3}{4}'' = 1$ ft.



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Begin with Fig. 2, the *elevation of the doorway*, and draw the center line *a b* at a distance of 5⅛ inches from, and parallel to, the right-hand border line; then draw the floor line *x y* at right angles to *a b*, at a distance of 1 inch above the lower border line; the door opening being 5 feet wide, lay off 2 feet 6 inches on each side of the center line *a b*, and draw the jamb lines; then draw the head jamb lines of the door opening at a distance of 10 feet above the floor line. Dividing the width of the opening into 8 equal parts will give 7½ inches as the measurement assigned for the module or semi-diameter of the column.

Construct the proportional scale of modules by drawing a line $\frac{3}{16}$ inch above the lower border line. Mark a distance of 3 feet 9 inches on this line, from a point ¾ inch from the left-hand border line; dividing this line into 6 equal parts will give 7½ inches, thus making the scale 6 m. in length. Subdivide the first module into 6 equal spaces, each of which will represent 5 p., or $\frac{1}{6}$ m.

The scale of ¾ inch = 1 foot must now be laid aside, as all measurements, except those relating to the wooden door, the thickness of the walls, and the lathing and plastering, are given in modules and parts of a module.

Draw the center line *l m* of the column at a distance of 6 m. 7½ p. from, and parallel to, the center line *a b*; then mark a series of points on the center line *l m*, representing the principal divisions of the order, beginning at *x y*, the floor line; mark a point, and draw the ground line at a distance of 24 p. below it; then, above it, mark, for the height of the plinth, 1 m. 28 p.; for the base of the column, 30 p.; for the shaft of the column, 14 m.; and for the capital of the column, 30 p.; for the architrave, 30 p.; and for the frieze and cornice, each 1 m. 15 p. Through these points draw the horizontal lines that define the members.

Now draw the line *g h* at a distance of 4 m. 20 p. above the top line of base *c d*, and on *g h* lay off 30 p. each side of the center line *l m*; draw the vertical lines down to the base parallel to the center line *l m*. Complete the profile of the base and plinth of the column as shown, the principal dimensions being figured; others may be obtained by scale measurement. Draw the capital of the column, locating the neck lines 25 p. each side of the center line *l m*; draw the moldings under the neck of the capital down to line *e f*.

Draw the profile of the entablature as shown, the moldings being drawn freehand; lay off and draw the triglyphs on the frieze, the guttæ of the same on the architrave, and lay off and draw the dentils on the bed mold of the horizontal cornice.

To determine the pitch of the pediment, describe an arc from the point *p*, at the lower angle of the crown mold of cornice, with a radius equal to the length of the facia fillet *p r*, which is 17 m. 17 p., intersecting with the center line *a b*; from this point as a center, and with the same radius, describe the arc *p q r*; then, from the point *q*, with a radius equal to the depth of the cornice less the crown mold, describe the arc as shown; from the point *p*, and tangent to this arc, draw the line of the fillet below the crown mold; parallel to this line draw the lines of the crown mold from the angles of the horizontal molding; make the facia, fillet, and bed-mold members the same width as those of the horizontal cornice, measuring, however, on a line at right angles to the pitch line of the pediment; the dentils of the pediment cornice are immediately over those of the horizontal cornice, so that their position can be projected from them.

The column, entablature, and pediment, having been drawn on the left of center line *a b*, duplicate the work to the right of the line, first drawing the center line of column *n o* and proceeding as before. This being done, draw the architrave around the door opening, and the piers situated behind the columns, as shown in Fig. 1; draw the plinth and base lines of the piers, and extend the entablatures over the piers.

Now draw Fig. 1, which is a *plan of the doorway* on the section line *g′ h′*; first draw *c′ d′*, the center or axial line of the columns, at a distance of 3¼ inches from, and parallel to, the upper border line; at a distance of 6 m. 7½ p. to the left of center line *a b*, draw the center line of column; this line is a continuation of the line *l m*, from which it may be projected; from the point of intersection of this line with the line *c′ d′*, and with a radius of 30 p., draw the plan of the shaft. At a distance of 21½ p. from line *c′ d′*, draw the face line of pier, and, at a farther distance of 30 p., the face line of the wall; draw the jamb line of the door opening and the return of the pier; draw the curves that represent the molded members of the base, the radii being procured from Fig. 2 by means of the compasses, with a center on the line *l m*; in a similar manner, transfer the measurements of the base and plinth blocks; locate and draw the architrave and the panel and molds of the jamb or reveal of the door opening. This being done on the left of the center line *a b*, the work may be duplicated to the right of this line.

Next draw Fig. 3, which is a *vertical section of the doorway* on the center line *a b* of Fig. 1.

Begin by drawing the center line *l′ m′* at a distance of $1\frac{9}{16}$ inches from the right-hand border line; then project the horizontal lines of the order from Fig. 2, profile the column and entablature by measurements transferred from Fig. 2, working from the center lines of the columns of each figure; observe that the face of the panel of the pediment is in line with the faces of the architrave and frieze, and that the full lines which subdivide the cross-hatched area represent the size of the stones composing the structure. Draw the joint line of the jamb adjacent to the base of column, after which divide the distance between this line and the head jamb into 6 equal parts and draw the joint lines; then project these lines to the piers of Fig. 2. Draw the joint lines across the face of the pediment cornice and horizontal cornice, as shown on Fig. 2, observing that these lines are at right angles with their respective members; project the pediment cornice-joint lines on Fig. 2 over to Fig. 3.

To draw the flutings of the shafts, begin by drawing from *t*, the center of the left-hand column in Fig. 1, the diagonal lines *t s* and *t u*, each at an angle of 45° from the axial line *c′ d′*. By means of a protractor, divide the angle of 90° contained between these lines into 5 equal parts of 18° each, and draw the radial lines of division; the intersection of these lines with the arc defining the shaft will give the *arrises* between the flutes.

To describe the curve of the flutes, set the bow-pencil to the chord of the arc between the angles of the flutes, and then from each angle describe an arc, as shown. The intersection of these arcs defines the center from which the curves of the flutes may be drawn with the same radius. One-third of the shaft having been filled in, the remainder can be drawn in a similar manner. The curves opposite the flutes represent the finish of the flutes on the apophyge at the base of shaft.

Having completed the plan to the left of the center line *a b*, draw the opposite one by the same process.

As the sides of shaft between lines *g h* and *v w*, on Fig. 2, are perpendicular, and of the same diameter as shown on the plan in Fig. 1, the lines of the flutings of this section can be projected from Fig. 1. But, in order to determine points for the curved outlines of the flutings between lines *e f* and *g h*, the semicircles that have been drawn on the lines *e f*, $3_1\,i$, $2_1\,j$, and $1_1\,k$, to profile the entasis, should be divided similar to the plan of shaft on Fig. 1.

Having marked the angles of the flutes on each semicircle, project the points by lines drawn parallel to center line *l m*, and intersecting with their respective base lines $1_1\,k$, $2_1\,j$, and $3_1\,i$. The points of intersection will give the desired points on the curved outline of each flute, through which, by the aid of a flexible strip, the curves may be drawn. The curved stops of the flutes at *e f* and *v w* can now be drawn.

Transfer the various points over to the column on the right of center line *a b*, and also to the column on Fig. 3, and complete the flutings.

The design having now been developed by means of the proportional scale and measurements, the drawing will be completed by means of the regular $\frac{3}{4}$ inch = 1 foot scale. Proceed to finish Fig. 1; draw the inner face line of the stone wall and the lines showing the furring strips and plastering on the inside of the wall; draw the door frame, which is 7 inches wide, and the door stops that cover the frame; draw the door, which is $2\frac{1}{2}$ inches thick, and lay off the framing, moldings, and the panels, all of which are shown in section. The dimensions of the framing and moldings can be procured from Fig. 2. Observe that the door is in two leaves, the central joint being rabbeted. Draw the door elevation on Fig. 2 by projecting the vertical lines from Fig. 1; make the lower rail 14 inches wide, the lower panel $16\frac{1}{2}$ inches high, each of the lock-rails $3\frac{3}{4}$ inches wide, and the lock-panel 6 inches wide. Draw the raised and ornamental panels as shown; run a series of vertical and horizontal lines to locate the center of the studs on the door framing, and from the centers found describe the circles. Draw the escutcheon adjacent to lock-panel, in which is placed the Yale key cylinder and the door knob. The drawing can now be inked in, crosshatched where shown in section, the dimension and center lines drawn, and the dimensions neatly written. The reference letters may be omitted.

Any dimensions taken on the drawing with the scale of $\frac{3}{4}$ inch = 1 foot will give the working measurements, and it should be so figured if required for a working drawing.

## DRAWING PLATE, TITLE: RENAISSANCE DOORWAY

**15.** This plate shows a design for a rich stone doorway in the Renaissance style, drawn in elevation and section to a scale of $1\frac{1}{2}$ inches = 1 foot.

Commence the *elevation* by drawing the center line $a\,b$ at a distance of $8\frac{1}{2}$ inches from, and parollel to, the left-hand border line, and draw $c\,d$, the floor line, at a distance of $\frac{5}{16}$ inch above the lower border line.

As the door opening is 5 feet 6 inches wide, each reveal line will be 2 feet 9 inches from the line $a\,b$; draw the soffit line at a distance of $7\frac{3}{8}$ inches above the lower border line.

The height of the opening is 11 feet, or twice its width as marked, but only the upper and lower portions of the jambs are shown, as indicated by the broken or irregular lines.

The development of the design is based on a standard of proportion, of which the *module* is the unit of measure, as explained in the directions for drawing the orders. To establish the module in this example, divide the width of the opening into 10 equal parts, thus getting $6\frac{6}{10}$ inches as the module.

Draw the *proportional scale* where shown; mark a distance equal to one-half of the width of the door opening, and divide it into 5 equal parts, each of which will equal 1 m., and subdivide the first division of the scale into 30 parts, as shown. The scale of $1\frac{1}{2}$ inches = 1 foot should now be laid aside, as all subsequent measurements are given in terms of the proportional scale of modules. Proceed with the elevation to the right of the center line *a b*, completing as far as practicable one half of the figure before starting the other half.

Starting at the floor line, mark a series of points on the line *a b*, defining the heights of the plinth, base, and capital of the semi-column, and of the architrave, frieze, and cornice of the entablature; through these points draw horizontal lines.

Subdivide these members by a series of points, defining the position of their respective details, and draw the horizontal lines. At a distance of 1 m. 15 p. from the jamb line *e f*, mark the width of the architrave, and at a farther distance of 30 p. mark the width of the semi-column; then from these points draw the vertical lines.

Profile the molded section of the column and entablature as shown; draw *e g*, the miter line of the architrave, and, from the points of intersection of the horizontal lines with this line, draw the lines of the vertical members of the architrave; mark the points of subdivision of the architrave base block, and draw the lines. Draw the center line of the second facia of the architrave at a distance of 25 p. from the jamb line; locate the centers for the **pateræ**, or rosette-like ornaments, and with a radius of 5 p. describe the circles.

To draw the dentils in the bed mold of the cornice, divide the line *a′ h* into 49 equal parts, two of which will belong to each dentil, and one part to the channel between them.

Now draw Fig. *A*, which is a *transverse section of the jamb*

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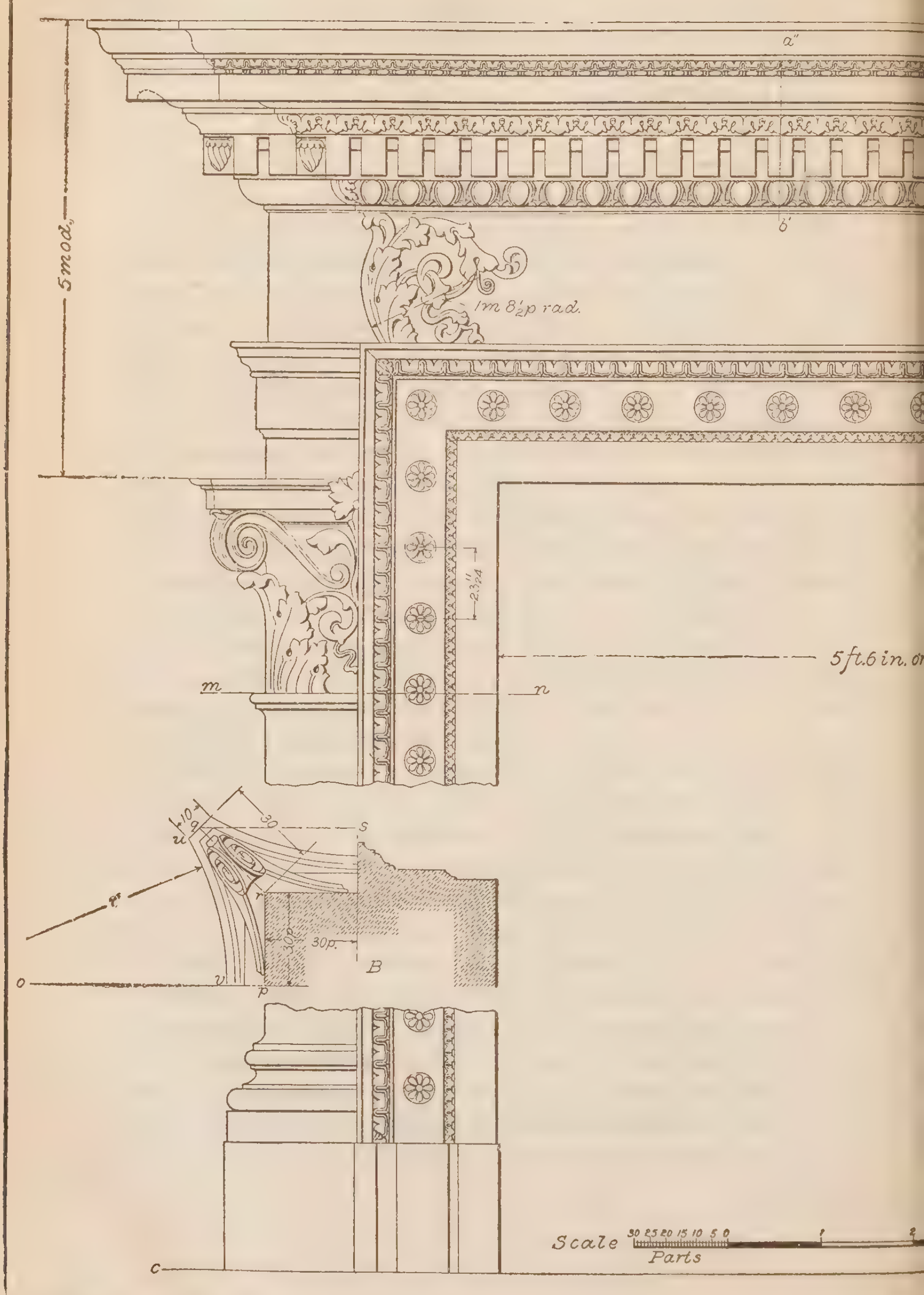

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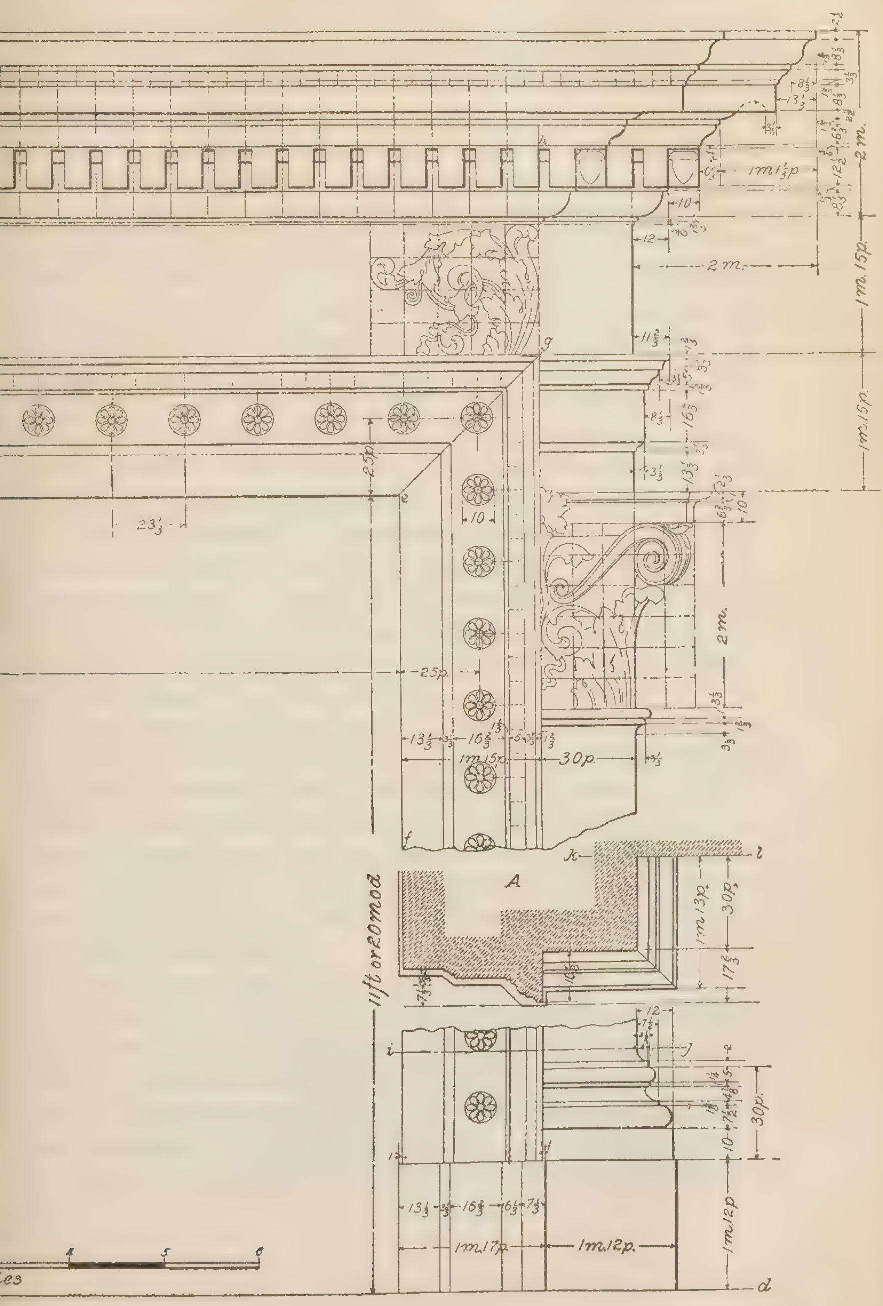

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on line *i j*, looking downwards; draw *k l*, the wall line, at a distance of $4\frac{3}{16}$ inches above the lower border line, and from the elevation project the lines of the architrave base block and the plinth and base lines of the column, and complete the section as shown.

Repeat the system followed in drawing the right-hand section of the elevation, on the left of center line *a b*. Draw Fig. *B*, which is a *transverse section of the jamb* on line *m n*, looking upwards, showing the plan of the capital, the leaves being omitted to prevent confusion. Locate *o p*, the wall line, at a distance $2\frac{7}{8}$ inches from the lower border line; from the point *r* draw the diagonal line *q r* at an angle of 45°, and equal in length to the line *r p*; draw the line *q u* at right angles to *q r* and mark the point *u*; draw *q s* parallel to *o p*. From *q* as a center, with a radius equal to twice the length of *q s*, describe an arc intersecting with the line *o p* produced; from this point of intersection as a center, describe the curve *u v*, which is the edge of the abacus; draw the opposite edge in the same manner, first locating a center for the curve on the outer edge of the architrave by means of an arc described from the point *q*; draw the parallel lines defining the molded members on the edges of the abacus, but omit the volute on the plan until it has been drawn on the elevation.

In order to draw the leaf ornament on the cyma-reversa moldings of the cornice, the center lines of the channels between the dentils should first be drawn. Observe that the width of each leaf of the lower molding occupies the full distance between these center lines, while in the upper cyma-reversa molding two leaves occupy the same space, so that on the upper molding there should be double the number of divisions shown below.

Having spaced off the length of the cornice to the left of the center line, sketch in a series of the leaf forms on both upper and lower moldings, and also the *pearl-and-bead* ornament of the upper molding as far as the line $a'' b'$; then on a piece of tracing paper make a copy of the ornament in pencil, and transfer it to the adjacent section, as explained before.

Draw the *egg-and-dart* ornament on the bed molding of cornice by the same method, observing that the center of each division of the ornament is immediately below the center of each dentil.

From the centers of the pateræ on the facia of the architrave, project a series of lines to the outer molding, observing that the distance between these lines is occupied by three leaves of the ornament on the molding. Sketch in a series of the leaves, and transfer by the method followed above; then draw in the leaves of the inner molding, as shown.

In order to establish the governing lines of the foliage and the volute of the capital, divide the height of the bell into 6 equal parts, and through the points of division draw horizontal lines; then draw five vertical lines, making the distances between them equal to the spaces between the horizontal lines, thus resolving the area into a series of squares.

Note carefully the points where the curved lines of the ornament intersect with the lines of the squares on the plate, and mark similar points on the drawing; these points will act as guides to the correct location of the curves, which should be sketched in lightly at first, and then strengthened; after which the design may be transferred to the opposite side by means of a copy on tracing paper. Draw the ornament at the end of the frieze in a similar manner, first dividing the height between members into 4 equal parts and constructing squares as before. The volute on Fig. *B* may now be sketched in, first drawing a series of vertical lines down from the volute on the elevation, so as to define the principal points governing the roll of the spiral, after which the drawing should be carefully compared with the plate and completed.

## DRAWING PLATE, TITLE: DOOR AND WINDOW TREATMENT

**16.** This plate shows a Gothic tracery window of four *days*, or openings, and a modern Romanesque doorway, both of which are drawn to a scale of $\frac{1}{2}$ inch = 1 foot.

Commence Fig. 1, which is the *elevation of the window*,

# DOOR AND W

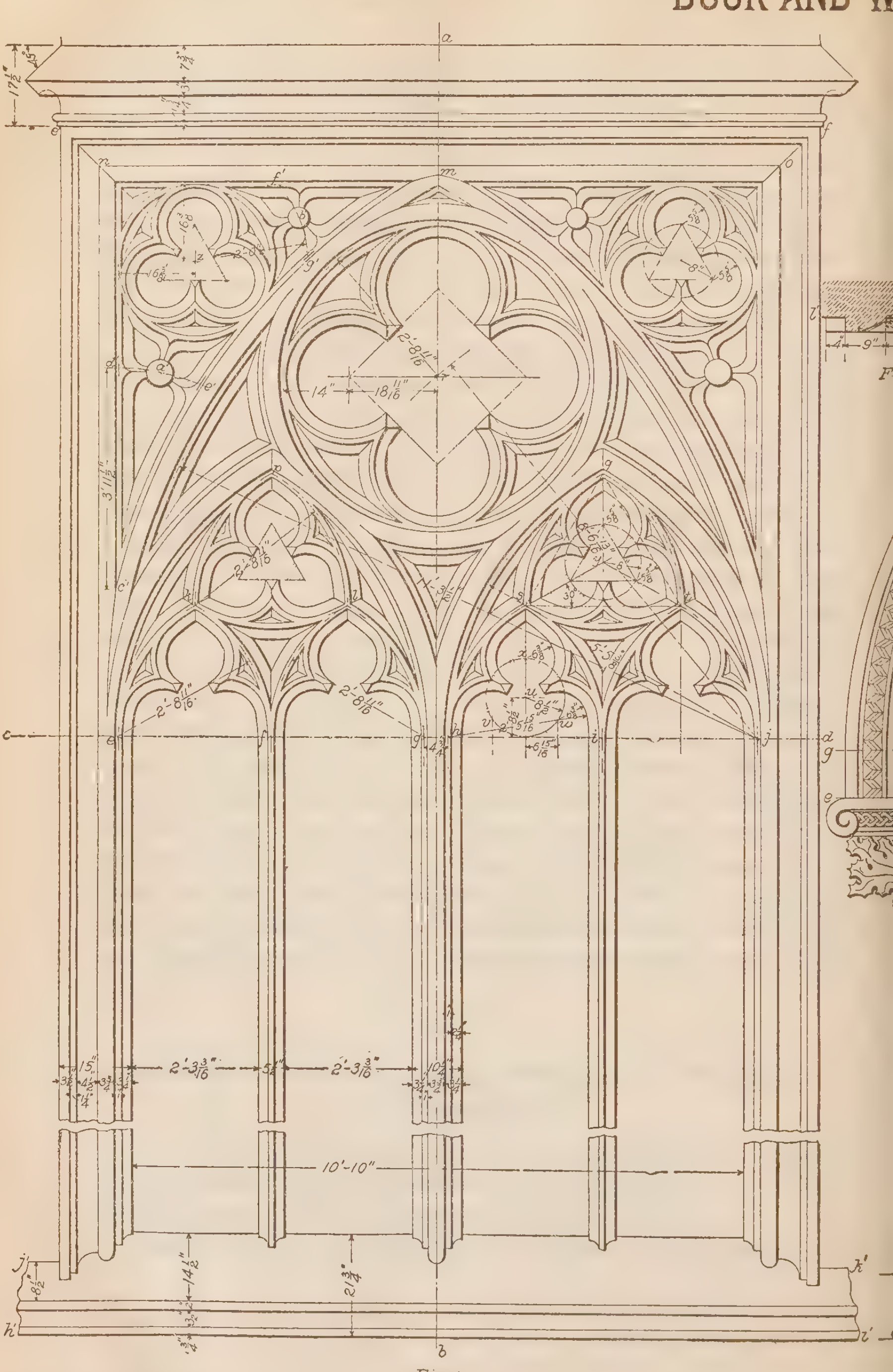

Fig 1.

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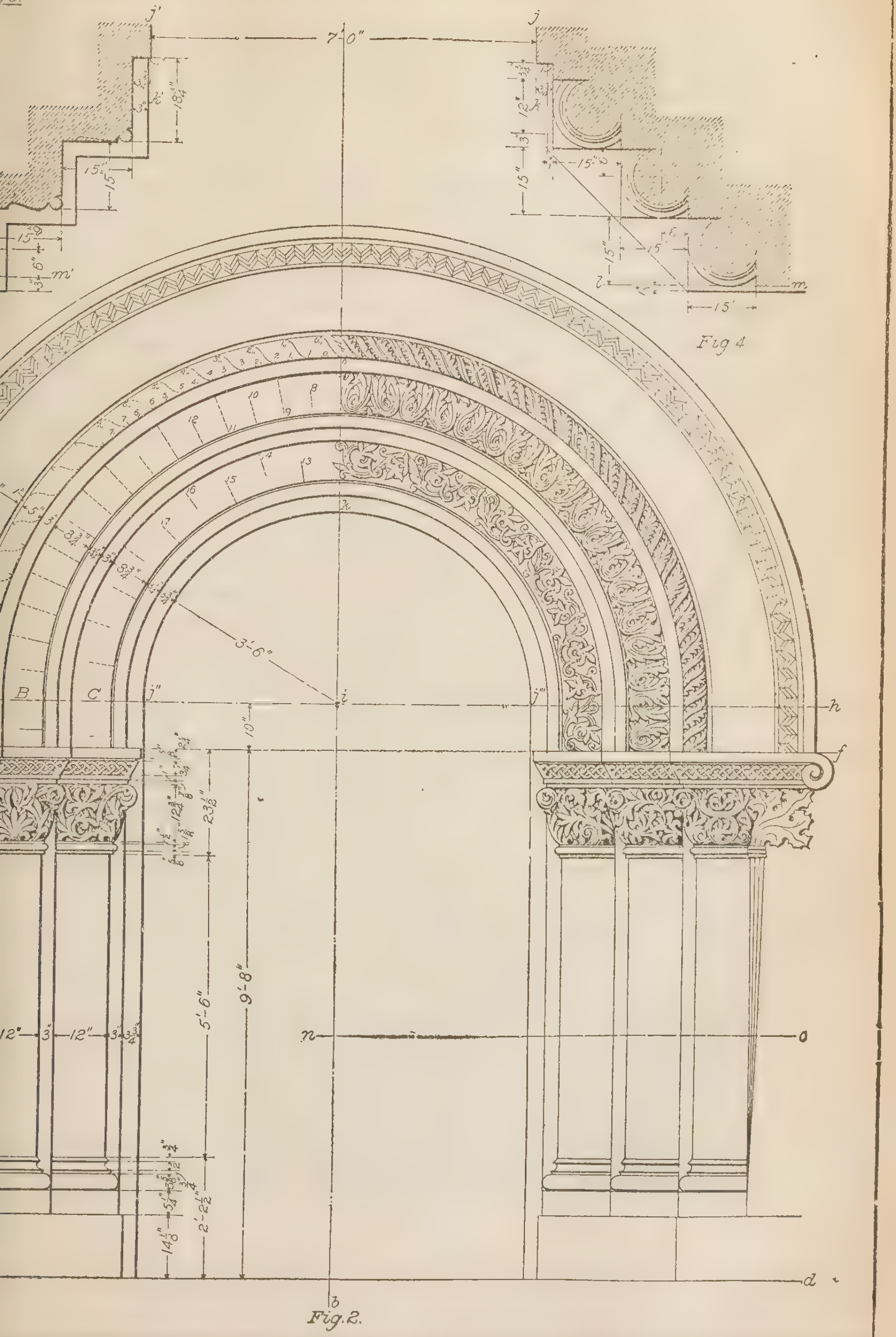


Fig 4

Fig.2.

by drawing the center line *a b* at a distance of $4\frac{1}{16}$ inches from, and parallel to, the left-hand border line; then draw the line *c d*, which is the springing line of the tracery, at a distance of $5\frac{7}{8}$ inches from, and parallel to, the lower border line.

The width of the window opening in the clear being 10 feet 10 inches, lay off one-half of this width on each side of the center line *a b*, and draw the reveal lines; from each reveal line lay off 15 inches, the width of the moldings on the jamb, and mark the width of each member of the moldings; then draw vertical lines down to the sill; locate the central and intermediate **mullions**, or vertical shafts, between the days of the window, in accordance with the figured dimensions, and draw the vertical lines down to the sill.

The tracery in the upper part of the window is based entirely upon a geometric system of construction, and its governing lines can be drawn without any other dimensions than the widths of the window and of its central mullion between certain established center lines. These center lines are taken through the middle of the fillets on the jambs and mullion of the window, as shown in Fig. 1 at *e g h* and *j*.

On the line *c d*, lay off on each side of the center line *a b* a distance of 5 feet $7\frac{3}{4}$ inches, thus locating the points *e* and *j*; and also lay off on each side of *a b* a distance of $2\frac{3}{8}$ inches, thus locating the points *g* and *h*. Now from *e* and *j* as centers, and with a radius *e j*, or 11 feet $3\frac{1}{2}$ inches, describe two arcs intersecting at *m*, and through their point of intersection draw a horizontal line, which will be the center line of the fillet at the top of the window head, as shown at *f*. Now, on *e*, *g*, *h*, and *j* as centers, and with a radius equal to *e g*, or 5 feet $5\frac{5}{8}$ inches, describe arcs intersecting at *p* and *q*; bisect *e g* and *h j* at *f* and *i*, and on *e* and *j* as centers, with a radius equal to *f j*, or 8 feet $6\frac{13}{16}$ inches, describe arcs intersecting at *r*. Now on *r* as a center describe a complete circle tangent to the arcs *j m* and *e m*. This circle will have a radius of 2 feet $8\frac{11}{16}$ inches, and should come within $4\frac{3}{4}$ inches of the arcs *g p* and *h q*. Now with this same radius, and on

$e$, $f$, $g$, $h$, $i$, and $j$ as centers, describe eight arcs intersecting at $k$, $l$, $s$, and $t$; and with these four points of intersection as centers, describe four arcs intersecting at $p$ and $q$; and from $p$ and $q$ as centers, describe the two arcs $k\,l$ and $s\,t$. Now through $e$ and $j$ draw perpendicular lines to the top of the window, and the skeleton outline of the tracery is complete.

Now draw the cusps of the small arches under the arch $h\,q\,j$. From the centers $s$ and $t$ draw vertical lines down to the springing line $c\,d$, and locate the center $u$; then with a radius of $8\frac{1}{2}$ inches describe a circle; locate the centers $v$, $w$, and $x$ as shown, $v$ and $w$ being at the intersections of the circumference of the circle with two vertical lines drawn $6\frac{15}{16}$ inches each side of the center line, while $x$ is at the intersection of the circumference with the center line itself; from these points, with a radius of $6\frac{3}{8}$ inches, describe the inner lines of the cusps; from points $h$ and $i$ describe the rib curves which are parallel to these cusp curves; locate similar centers for the cusps under the arch $i\,t\,j$; draw the cusps and then the rib curves as before. To determine the center of the spherical triangle $s\,q\,t$, bisect the angles $q\,s\,t$, $q\,t\,s$, and $s\,q\,t$, and the intersection of these bisecting lines at $y$ will be the center required. From $y$ as a center, with a radius of 8 inches, describe a circle; within this circle draw an equilateral triangle, by joining the points of intersection of the circle with the bisecting lines; from each vertex of this triangle as a center, with a radius of $5\frac{5}{8}$ inches, draw the curves of the cusps; complete the trefoil by drawing the parallel rib curves from the centers $s$, $q$, and $t$, and draw the moldings composing each rib; the small spandrels adjacent to the cusps are called *eyes*, and are panels cut in the face of the rib to lighten its appearance, but are not cut entirely through the stonework, as are the days.

Draw the cusps which form the **quarterfoil,** or four-leafed figure, in the circular section of the window; from the center $r$, with a radius of $18\frac{11}{16}$ inches, draw a circle; through $r$ draw a vertical and a horizontal line; the intersection of these lines with the circle just drawn will define the centers from which arcs may be struck to form the cusps; draw diagonal lines from these points, which will define the length of the cusps, and complete the figure, as shown.

To draw the tracery of the large spandrels, first locate the center *z* according to the measurements given; from *z* as a center, with a radius of 16$\frac{3}{8}$ inches, describe a circle, which will be the center line of the circular rib; draw another circle from the same center with a radius of 8 inches, as shown in the right-hand spandrel, and inscribe an equilateral triangle, as shown; then from the vertices of this triangle as centers, and with a radius of 5$\frac{5}{8}$ inches, describe the curves of the cusps forming the trefoil, and complete the figure, as shown.

From the point $c'$ as a center, with a radius of 3 feet 11$\frac{1}{2}$ inches, describe the arc $d' e'$; bisect this arc, establishing the center $a'$, from which, with a radius of 2$\frac{3}{4}$ inches, the small circle may be drawn; draw the center line of the cusps which radiate from it; then draw the cusps themselves.

From the center *z*, with a radius of 2 feet, describe the arc $f' g'$; bisect the arc and establish a center at $b'$, from which, with a radius of 2$\frac{1}{4}$ inches, describe the small circle; draw the center line of the cusps that radiate from it, and draw the cusps as before; then complete the tracery throughout. Draw the hood molding over the window, first locating the horizontal lines and then drawing the profile.

Draw $h' i'$, the bed line of the window sill, at a distance of $\frac{9}{16}$ inch above the lower margin line; then draw the top line of sill 21$\frac{3}{4}$ inches above this line; draw the lines of the drip mold of sill adjacent and parallel to line $h' i'$; draw the profile of the jamb molds and mullions, which **detail,** or describe, their outline, on the sloping surface of the sill; the line $j' k'$ is the line of intersection of the slope with the vertical face of the wall at the sides of the window.

The continuity of the jamb molds and mullions is broken by the irregular lines that separate them, indicating that the total height of the window is not shown; this height would be from 4 feet to 6 feet greater.

Now draw Fig. 4, which is a *plan of the jamb of the Romanesque doorway* taken on the line *n o* of Fig. 2. Begin by drawing the vertical center line *a b* at a distance of $4\frac{15}{16}$ inches from, and parallel to, the right-hand border line; then draw *l m*, the face line of the wall, at right angles to *a b* and at a distance of $3\frac{3}{8}$ inches below the upper border line; the width of the doorway being 7 feet, the position of *j k*, the reveal line, will be 3 feet 6 inches from the center line *a b*.

From *j k* lay off the lines representing a series of three reveals; receding from the door opening, the first is $3\frac{3}{4}$ inches from *j k*, the second and third each at farther distances of 15 inches; from *l m* lay off the horizontal lines representing the receding face lines, three being at distances of 15 inches apart, and the inner one at a distance of $3\frac{3}{4}$ inches; locate the centers of the shafts and draw their plans, with a radius of 6 inches, as they are each 12 inches in diameter.

Draw the outer curves from the same centers, indicating the members that compose the bases; then draw the angular line showing the edge of the plinth block on which the bases of the shafts rest.

Next draw Fig. 3, which is a *plan of the arch moldings* taken on the springing line *g h* of Fig. 2. Draw $j' k'$, the reveal line, at a distance of 3 feet 6 inches from the center line *a b*; locate the angles of the recessions by the measurements given, and draw the angle and face molds and the line of the abacus on top of the capitals of the columns.

Now proceed with Fig. 2, the *elevation of the doorway.* Draw the ground line *c d* at right angles to center line *a b*, and at a distance of $\frac{9}{16}$ inch above the lower border line; at a height of 9 feet 8 inches above the line *c d*, draw *e f*, the impost line; then draw *g h*, the springing line, at a distance of 10 inches above the line *e f*.

From the point *i* as a center, with a radius of 3 feet 6 inches, draw the curve $j'' k j'''$; from $j''$ and $j'''$, the points of intersection of this curve with the line *g h*, draw the vertical reveal lines of the door opening.

From the point $j''$, on the line *g h*, mark the width of the various arch members, in accordance with the measurements given; from point *i*, with radii extending to these points, draw the curved lines as shown.

From the line *c d*, on the center line *a b*, mark a series of points locating the vertical measurements of the plinth course and the bases of the shafts, and through these points draw horizontal lines; then, from the line *e f* on the center line *a b*, mark a series of points representing the vertical measurements of the capitals of the shafts, and through these points also draw horizontal lines.

From Fig. 4 project the shafts and base lines, and repeat them on the opposite jamb; then draw the moldings of the capitals and bases.

As the ornament on angle mold *A* and on the facias *B* and *C* is composed of repeated sections, it will only be necessary to draw one section of each correctly, which can be transferred and duplicated on the adjacent sections, and the operation continued until one-half of the arch has been occupied, as shown.

Divide the inner curve of the angle mold *A*, from the line *g h* to the center line *a b*, into 17 equal parts, and mark the points *0*, *1*, *2*, *3*, *4*, *5*, *6*, *7*, etc.; then, from each of these points, with the dividers set to 4¼ inches, mark a second series, as $0_1$, $1_1$, $2_1$, $3_1$, etc.

From the center *i*, draw radial lines through these secondary points, and mark their intersections with the outer curve of *A*, as $0_{11}$, $1_{11}$, $2_{11}$, $3_{11}$, etc.; then draw the lines $0\text{–}0_{11}$, $1\text{–}1_{11}$, $2\text{–}2_{11}$, $3\text{–}3_{11}$, etc.; on each of these lines draw a reversed curve, as shown, representing the center line of the reeded strap between the leaves.

Now, on the right-hand side of the center line *a b*, divide the angle mold *A*, the same as has been done on the left side; this done, draw freehand a series of three or four straps and leaves, sketching them very faintly and finishing them with a clean, even line; then, on a small piece of tracing paper, carefully trace the form, and on the back of the tracing paper rub a soft pencil, thus forming a transfer paper. Transfer the copy to the adjacent section, carefully observing that the center lines of the bands are over those already drawn; and trace over the form of the figure with a hard pencil, which will transfer the lead on the back of the tracing to the surface of the drawing, giving the outline of the figure, which should then be strengthened with a hard pencil. Continue this operation until the ornament on one-half of the molding is completed.

In order to locate the sections of the ornament on facia *B*, divide the inner curve of the quadrant from line *gh* into 16 equal parts, as *8*, *9*, *10*, *11*, *12*, etc.; and repeat the divisions on the right-hand quadrant; then draw freehand four or five sections of the ornaments, carefully outlining the ribs and leaves, taking care to make a neat rendering, which may then be traced and transferred, as explained above.

To draw the ornament of facia *C*, divide the outer curve of the quadrant into 10 sections, as *13*, *14*, *15*, *16*, *17*, etc.; repeat the divisions on the right-hand quadrant, and draw freehand four or five sections of this ornament, taking care to make the curves of the tendrils easy and graceful, and then transfer them as before. Draw the chevron ornament on the chamfer of the hood mold, as shown.

Draw the guilloche ornament on the chamfer of the abacus, making the angle of the interlacing reeds 45°; then draw freehand the scroll formed by the fillet of the abacus.

Draw the angular stalk represented by the rib lines which are united by the reeds at the collar of the shaft. Draw the leaf growing out of the stalk, forming the veins by graceful curves, and giving the lobes a sharp and angular outline, which is characteristic of this style.

Next draw the capitals, outlining the tendrils, which finish in a foliated cluster at the angle of each capital. Observe that the tendrils start near the center of the shaft and form well-defined lines as they approach the cluster. Sketch them first very faintly, and endeavor to obtain graceful, easy curves, as they form the growth line of the design from which the leaves branch; draw the ribs of the leaves, and arrange their lobes as near the position shown on the drawing as possible.

# EXAMI

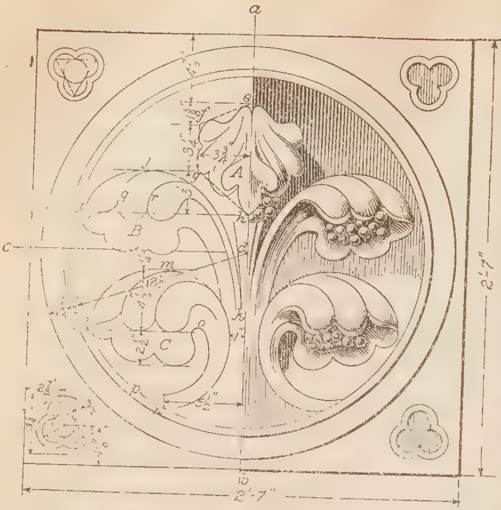


Fig 1.

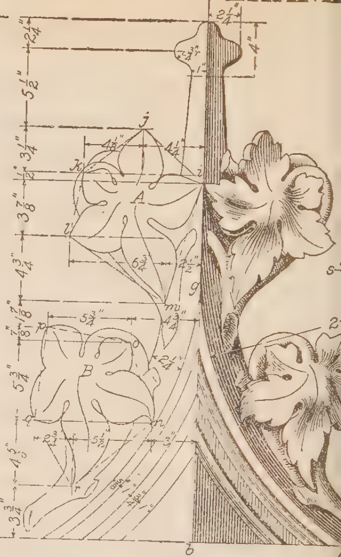


Fig. 2.

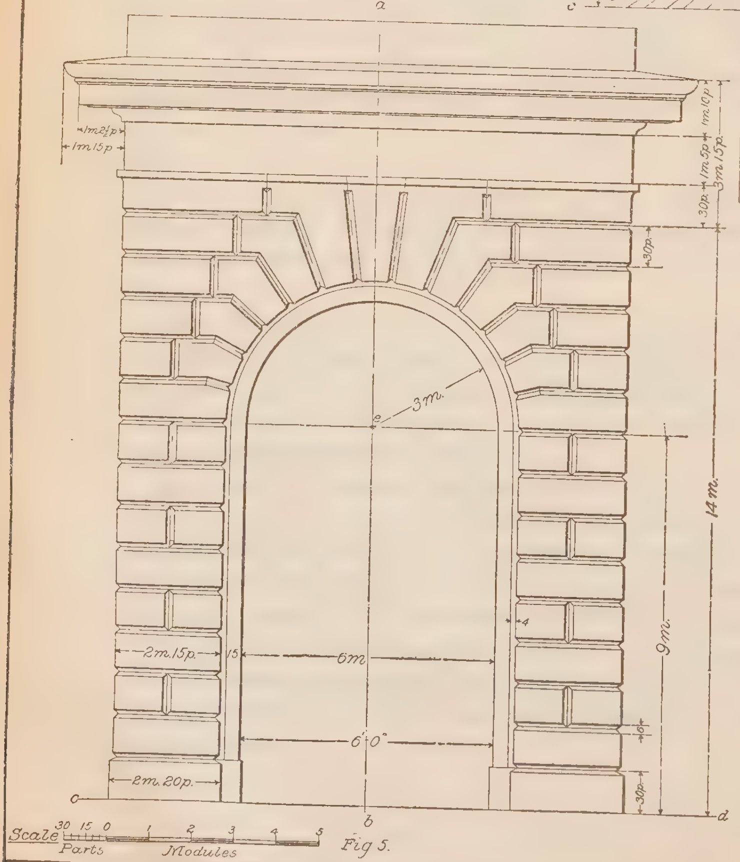
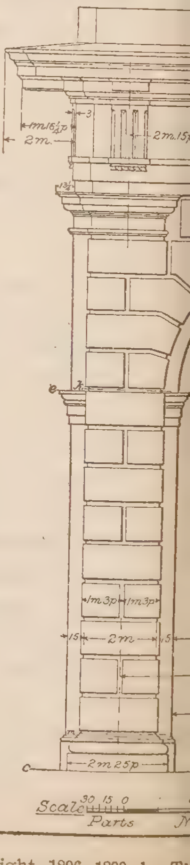


Fig 5.



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## DESIGN.

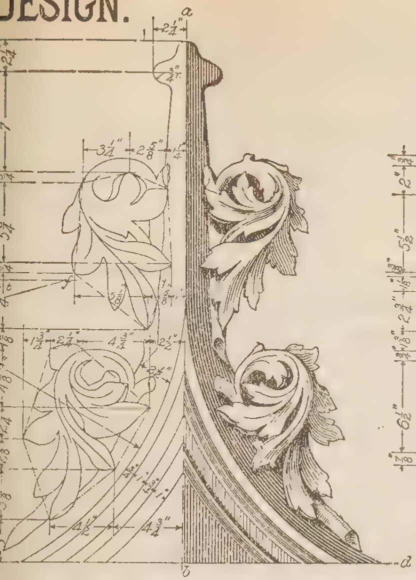

Fig 3.

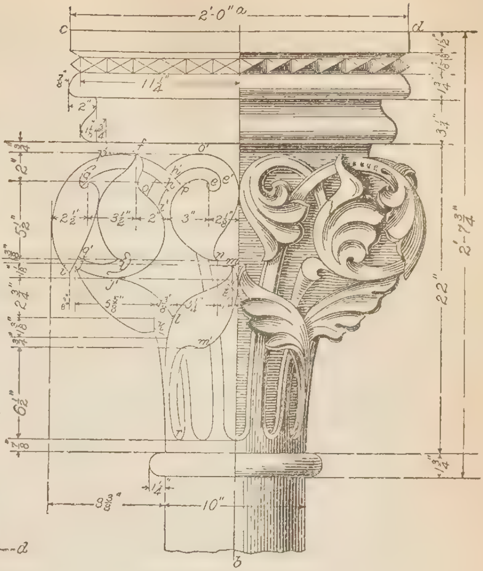

Fig.4.

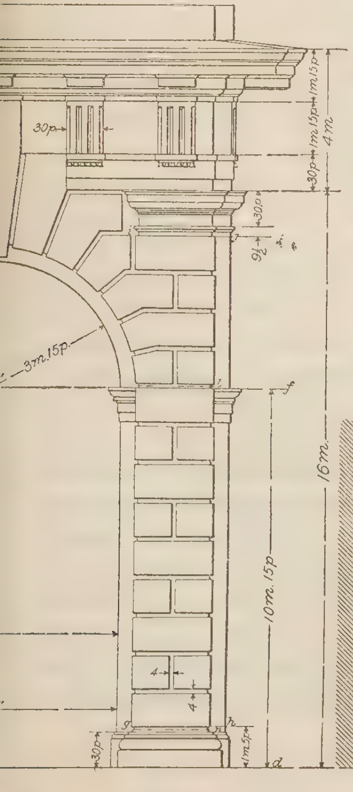

Fig.6.

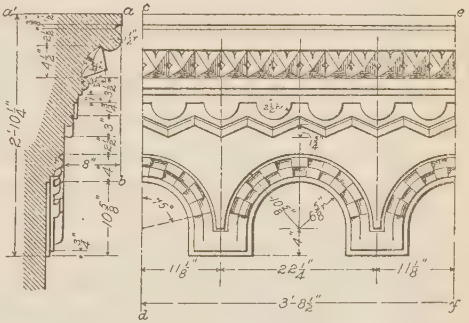

Fig. 7.

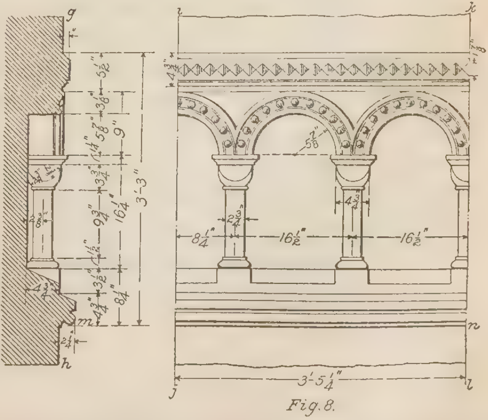

Fig.8.

## DRAWING PLATE, TITLE: EXAMPLES IN DESIGN

**17.** This plate illustrates a number of *architectural details* in the Gothic and Renaissance styles.

Figs. 1, 2, 3, and 4 are Gothic details, drawn to a scale of $1\frac{1}{2}$ inches = 1 foot. Figs. 5 and 6 are Renaissance doorways, drawn to a proportional scale. Figs. 7 and 8 are Romanesque or early Gothic details, drawn to a scale of $\frac{3}{4}$ inch = 1 foot.

Begin Fig. 1, which is an *elevation of a decorated panel*, by drawing the center line *a b* at a distance of $2\frac{11}{16}$ inches from, and parallel to, the left-hand border line; draw *c d*, the horizontal center line of the panel, at a distance of $2\frac{9}{16}$ inches below, and parallel with, the upper border line; from the center *d*, with a radius equal to one-half the side of the panel, which will be 1 foot $3\frac{1}{2}$ inches, describe arcs intersecting the vertical and horizontal lines; through the points of intersection draw the lines defining the sides of the square.

From the center *d*, with the radii given, describe the lines of the circular molding; from the measurements given, locate the centers of the small trefoil panels in the corners; from each center, with a radius of $2\frac{1}{8}$ inches, describe a circle; then, with a radius of $1\frac{3}{4}$ inches, describe an inner circle; within the inner circle draw an equilateral triangle, as shown. Within this triangle inscribe a circle, from the center of which draw lines to the vertices; the intersection of these lines with the inner circle will define the centers for the **foils,** or leaf-like spaces, between the **cusps,** or spear points, formed by the circles composing the foils. By increasing the radius $\frac{3}{8}$ inch, the molded edge of each cusp may be drawn.

In drawing the foliage of a figure, where each half is symmetrical, it is more expedient to sketch one-half of it in outline, showing only the governing lines, which, being satisfactorily drawn, will simplify the execution of the finer detail. This system is followed in Figs. 1, 2, 3, and 4, as it tends to give the student a clearer idea of the composition. It will be necessary, however, to locate carefully several points defining the relative position of each leaf of the group.

Beginning with leaf *A*, of Fig. 1, locate the points *e*, *f*, *g*, and *h* by the measurements given, and connect these points with the dotted outline. From points *g* and *h* draw horizontal lines defining the space occupied by the upper portion of the leaf *B*; the center line *c d* will give the relative position of the lower portion of this leaf. From the center line *c d*, locate and draw the horizontal lines that limit the outline of the lower leaf *C*. Returning to leaf *A*, draw freehand, in faint outline, the **lobes,** or divisions, of the leaf. In drawing the foliage, the student should try to obtain easy and graceful curves, and, when satisfactorily drawn, he should strengthen the lines, using an irregular curve where practicable.

Now draw freehand the upper line *i j k* of leaf *B*, always drawing the curves downwards, as from *j* to *i*, then from *j* to *k*. Draw the scalloped edge of the lobes, and from the points *q* and *r* draw the curved edges of the lobes that unite tangentially with the upper line *i j k*, drawing from the line *i j k* downwards to the scallop; then sketch the stem lines, until they die in the stalk. Draw the upper line *l m n* of leaf *C*, drawing from *m* to *l* and from *m* to *n*. Then draw the scalloped edging and the curved edges of the lobes that unite with the line *l m n*, and draw the stem line *o p*, sketching from *o* to *p*.

Having satisfactorily drawn the outline of the leaves on the left side of the figure, proceed in a similar manner with the right side; then finish the various details of the leaves, and draw the grapes as shown.

Proceed with Fig. 2, which is an *elevation of a gable finial*, decorated with foliated **crockets,** or bent branches, over which the leaves are laid. Draw the center line *a b* at a distance of $6\frac{11}{16}$ inches from, and parallel to, the left-hand border line, and draw the line *c d* of indefinite length, at a distance of $5\frac{1}{4}$ inches from, and parallel to, the upper border line. Draw the line *e f* at a distance by scale of 20 inches above the line *c d*; then locate the point *f* at a distance of 2 feet $\frac{1}{8}$ inch from the center line *a b*; from *f* as a center, with a radius of 2 feet $\frac{1}{4}$ inch, describe the curve *g h*, defining the top line of the molding; and from the same center draw the parallel lines of the various moldings of the coping, the upper face of which is worked ∧-shaped, and, being drawn together at the top, forms a lozenge-shaped section at the neck of the trefoil head.

To draw the curves on the left of the center line $a\,b$, produce the line $e\,f$ over to the left-hand side, on which locate the center in the same relative position as the center $f$; then draw the curve of the gable and the trefoil head of the finial. Now outline the foliage on the left side of the figure; first draw a series of horizontal lines in accordance with the measurements given; then locate the points $i$, $j$, $k$, $l$, and $m$ of the enclosing figure of leaf $A$, and also the points $n$, $o$, $p$, $q$, and $r$ of the enclosing figure of leaf $B$. Sketch faintly the outline of each lobe of the leaves, uniting them by looped curves, as shown, and strengthening the lines when satisfactorily drawn; then draw the vein lines of each lobe, and the outline of the sprigs. Having finished the left-hand side, repeat the design to the right of the line $a\,b$, and then finish this side in detail as shown.

Proceed with Fig. 3, which is similar to Fig. 2, except the crockets, which have a different form of foliage. Draw the center line $a\,b$ at a distance of $10\frac{3}{4}$ inches from, and parallel to, the left-hand border line; draw the line $s\,t$ at a distance of $19\frac{1}{2}$ inches, by scale, above, and parallel to, the line $c\,d$; locate the center $s$ at a distance of 1 foot $10\frac{1}{2}$ inches to the left of center line $a\,b$, and draw the curves of the coping molds; produce the line $s\,t$ to the opposite side, on which locate the center, from which the curves may be drawn; then draw the inclined lines that converge towards the top of the finial, and draw the trefoil head of same. Now draw the outlines of the foliage on the left side of the figure, locating the points of the enclosing figure of each leaf by means of the horizontal lines and measurements given, drawing the outline of the foliage and sprigs; then repeat them on the adjacent side, as directed by the preceding figures.

Commence Fig. 4, which is an elevation of a *Romanesque* or *early Gothic capital*. Draw the center line $a\,b$ at a distance of $2\frac{7}{16}$ inches from, and parallel to, the right-hand border line; draw $c d$, the top line of the abacus, at a distance of $\frac{5}{8}$ inch below the upper border line. From the line $c d$, mark a series of points on the center line $a b$, locating the divisions of the capital; then, from the dimensions given, draw the profile of the moldings and the body of the left side of the capital. Now draw the foliage, first locating the points $e, f, g, h, i, j, k, l, m$, and $n$, defining the tips of the leaves and the intersection of the stem lines. This done, commence on the foliage by drawing from $p'$ to $i$; then from $g$ to $i$; from $f$ to $q$; from $f$ to $o$; from $o$ to $j''$; from $j$ to $j''$; from $o'$ to $n$; and from $e$ to $n$. Draw from $p'$ to $p$; from $g$ to $h$; from $q'$ to $q$; from $o'$ to $o$; from $h$ to $i'$; from $h'$ to $e'$; then from $e$ to $e'$ draw the loops defining the overlaps at $g$ and $q$, which completes the outline of the upper section of the foliage.

Draw from $j$ to $k$; then draw the lines $m l$, $j j'' l$, $m m'$, $m' r$, and finish by drawing the stem lines. This done, repeat the operation on the opposite side, and complete the details as shown.

Begin Fig. 5, which is an *elevation of a Renaissance doorway*, by drawing the center line $a b$ at a distance of $3\frac{3}{16}$ inches from, and parallel to, the left-hand border line, and draw $c d$, the ground line for Figs. 5 and 6, at a distance of $\frac{9}{16}$ inch above the lower border line.

The door opening is 6 feet wide, and should be laid down to a scale of $\frac{3}{8}$ inch = 1 foot. This done, divide the width into 6 equal parts, one of which will determine the *module*, or unit of proportion.

Draw a scale of modules as shown, making its length equal to the width of the door opening, which, divided, will define the modules. Subdivide the first one into 6 equal spaces, each of which will represent 5 p.

At a distance of 9 m. above the ground line, draw the springing line of the arch, and from the center $e$, which is located on the center line $a b$, with a radius of 3 m., describe the *soffit* line, or under side, of the door opening; on the springing line, mark the position of the jamb and pier lines, and describe the curves from the center $e$.

From the intersection of the curves with the springing line, draw the vertical lines to the ground line *c d*; on the center line *a b* mark a series of points defining the horizontal lines of the entablature and the course that surmounts it. Divide the distance between the ground line and the architrave into 14 equal courses of 1 m. each, and draw the horizontal joint lines; divide the soffit line of the arch into 13 equal parts, and draw the joint lines radiating from the center *e*.

Locate and draw the vertical joint lines, then mark the width of the **chamfer,** or splayed edge of the courses, which is 3 p. on each side of the joint line. Draw the lines and show the cut of the chamfer, which has a bevel of 45°, as shown on the returns. Draw the profile of the entablature and finish the figure.

Begin Fig. 6, which is also an *elevation of a stone doorway of the Renaissance style*, by drawing the center line *a b* at a distance of $9\frac{1}{16}$ inches from, and parallel to, the left-hand border line.

The opening is 6 feet wide, and should be laid down to a scale of $\frac{3}{8}$ inch = 1 foot. This done, divide the width into 7 equal parts, one of which will determine the module.

Draw a scale of modules as shown, making its length equal to the width of the door opening, subdividing the first one into 6 equal spaces, each being 5 p.

At a distance of 10 m. and 15 p. above the line *c d*, draw the springing line of the arch; from the center $e'$, with a radius of 3 m. 15 p., describe the soffit line of the door opening; then, with a radius increased to 4 m., describe the soffit line of the outer arch; from the intersection of the arch lines with the springing lines, draw the vertical reveal lines; on the springing line, mark the width of each *pilaster* and pier, and also the position of center line of each pilaster, and draw the vertical lines.

At a distance of 16 m. above the line *c d*, draw the lower line of the entablature; then, at a distance of 4 m. above this, draw the upper line of the entablature; divide the entablature into architrave, frieze, and cornice, according to the measurements given, and subdivide these members into their respective details by measurements taken from the scale, and draw the horizontal lines. Draw the profile of the entablature, observing that the frieze and lower facia of the architrave are in line with the neck of the capital and the return line of the pier; draw the triglyphs in the frieze, the guttæ on the architrave, and the mutules under the corona, as shown.

Draw the horizontal lines and profile the members of the capitals and bases of the pilasters and piers, locating the subdivisions by means of measurements taken from the scale on the plate.

Draw *g h*, the bed line of the first course above the base of the pilaster; in order to locate the courses composing the pilaster up to the top of the impost or springing line *e f*, mark a point on the center line of each pilaster 2 p. above the line *e f* and draw the line *k l*, this measurement being one-half of the width of the channel or groove between the courses; then mark a point at a distance of 2 p. below the line *g h* and draw the line *m n*; divide the vertical distance between the lines *k l* and *m n* into 9 equal spaces, which will define the center of each channel.

Lay off 2 p. on each side of these centers, and draw the lines of the *rustic*, or projecting portion of each course, as shown.

**Bossage,** or **rustic work,** is a style of ashlar masonry in which the joints are worked so as to form grooves or channels, which may be rectangular, as shown in Fig. 6, or beveled, as shown in Fig. 5. There are several variations of this style of masonry, all of which are intended to give an appearance of bold-relieved surface and massive effect.

Mark a point 2 p. above the line *i j*, and divide the distance between this point and the line *k l* into 4 equal parts; then space the channels and draw the rustic lines; divide the soffit line of the arch into 13 equal parts; from the center *e*, through the points marked, draw radial lines, on each side of which mark one-half the width of the channel, or 2 p., and draw the rustic lines parallel to the radial lines, intersecting with the horizontal channels, as shown. Draw the horizontal lines and profile the members of the moldings composing the imposts of the piers, by means of scale measurements; draw the vertical lines of the rustic work and complete the figure.

Commence Fig. 7, which is an *elevation and section of a Norman or early Gothic parapet*, drawn to a scale of $\frac{3}{4}$ inch = 1 foot, by drawing the *section* to the left, which is taken on the line *c d*.

Draw the line *a b* at a distance of $3\frac{3}{4}$ inches from, and parallel to, the right-hand border line; draw *a′a*, the top line of the parapet, at a distance of $6\frac{3}{4}$ inches above the lower border line. From the line *a′a* mark a series of points defining the vertical position of the members, and through these points draw horizontal lines; then draw the profile in accordance with the measurements given.

From the section project the horizontal lines over to the elevation; draw the vertical line *e f* at a distance of $\frac{3}{4}$ inch from the right-hand border line, and draw the vertical line *c d* at a distance of 3 feet $8\frac{1}{2}$ inches by scale from the line *e f*. Locate the centers for the lower arches and draw them, and subdivide the arch mold into *billets*, or short sections, as shown. Draw the *chevron*, or zigzag, mold of the lower facia, and the scalloped edge of the second facia, which overlaps it.

Draw the **dog-tooth** ornament, which is a four-leaved ornament, having the center projecting, and finishing in a point, as shown. First draw the ornament in position on the section, projecting the several points over to the elevation; then complete both figures.

Now draw Fig. 8, which is an *elevation and section of a Norman arcade*, drawn to a scale of $\frac{3}{4}$ inch = 1 foot. Begin the section, which is taken on the line *i j*, by drawing *g h*, the face line of the wall, in line with the wall face of the section of Fig. 7, and draw *m n*, the bed line of the sill mold, at a distance of $\frac{15}{16}$ inch above the lower border line; on the line *g h*, mark the points defining the vertical position of the various members, and draw horizontal lines; draw the shaft, base, and cap in position, as shown, and profile the molded courses and arch mold, and project the horizontal lines of the section over to the elevation; draw the vertical line *k l* immediately under the line *e f* of Fig. 7, and draw the line *i j* at a distance of 3 feet $5\frac{1}{4}$ inches from the line *k l*; locate and draw the center lines of the columns and arches. Profile the columns and draw the arch molds; locate and draw the *ball ornament* and the *lozenge ornament* on the face of the molded string-course surrounding the arches, and complete the figure.

## DRAWING PLATE, TITLE: GOTHIC ARCADE

**18.** This plate shows a French Gothic arcade, drawn to a scale of $1\frac{1}{2}$ inches = 1 foot.

Commence with Fig. 1, which is a *plan of the pier* on line *q r*, looking downwards; draw the center line *a b* at a distance of $2\frac{7}{16}$ inches from, and parallel to, the left-hand border line; draw *g h*, the wall line, at right angles to line *a b* and at a distance of $1\frac{7}{16}$ inches below the upper border line. Locate the centers of the shafts, and draw the circles defining the shafts with their bases—the measurements of the details being given on Fig. 2, from which the plan can be drawn and completed.

Proceed with Fig. 2, the *elevation of the arcade*, by drawing the vertical center lines *c d*, *e f*, and *c′ d′* at their respective distances from, and parallel to, the center line *a b*. Draw *i j*, the floor line, at a distance of $\frac{7}{16}$ inch above the lower border line, after which mark a series of points on the line *c′ d′*, locating the principal horizontal divisions of the design; thus, at a distance of 11 inches above *i j*, mark a point denoting the top of the base; at a farther distance of 3 feet 5 inches, the top of the shaft; then $10\frac{1}{2}$ inches for the capital; $4\frac{1}{2}$ inches for the impost; $8\frac{3}{4}$ inches to *k l*, the springing line for the main arches; $15\frac{1}{4}$ inches to the line on which the centers of the quarterfoils are located; $21\frac{1}{2}$ inches to the bed line of the molded and decorated course; and $8\frac{3}{4}$ inches to the top line of the course; through these points draw

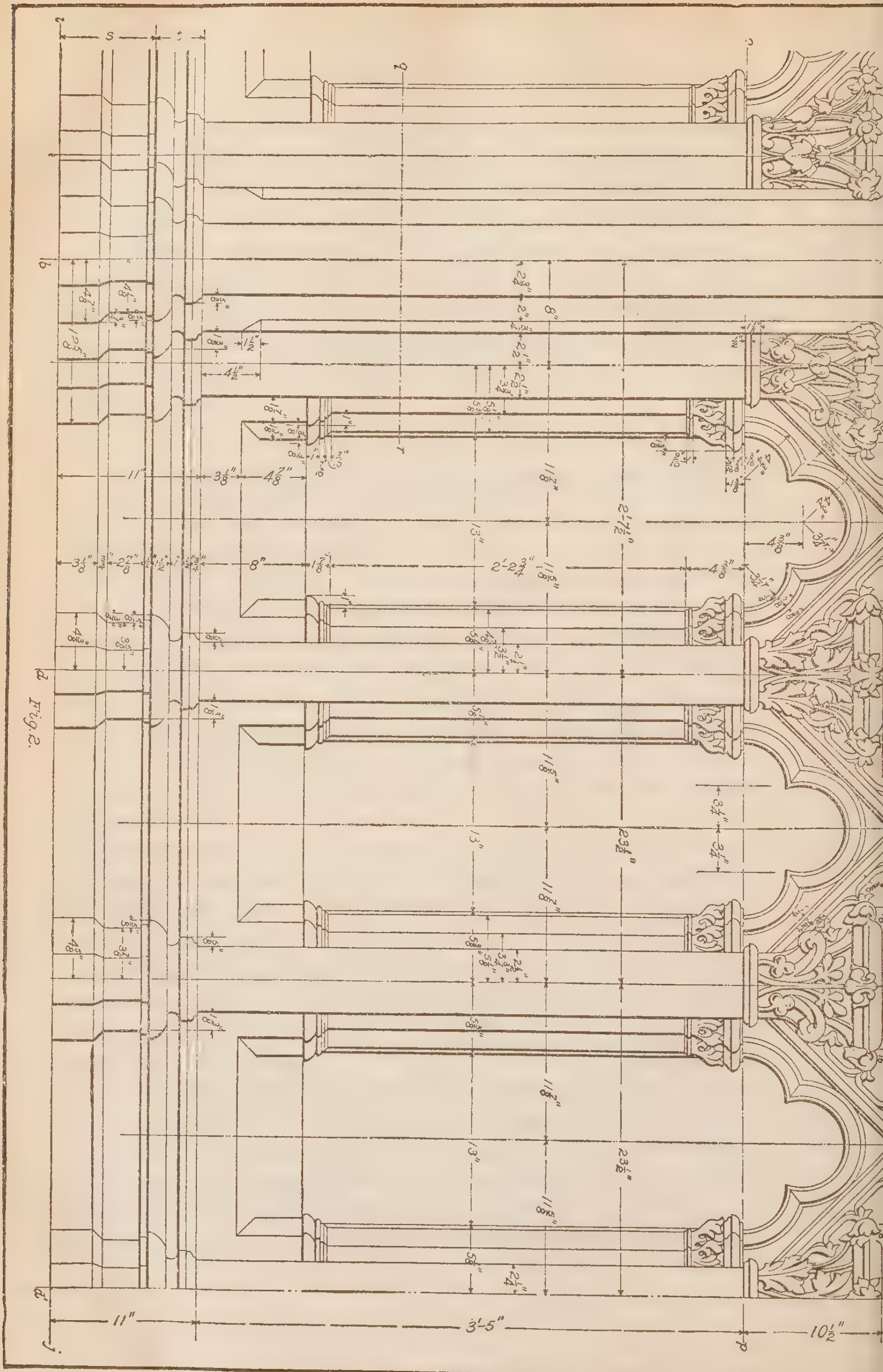

Fig. 2.

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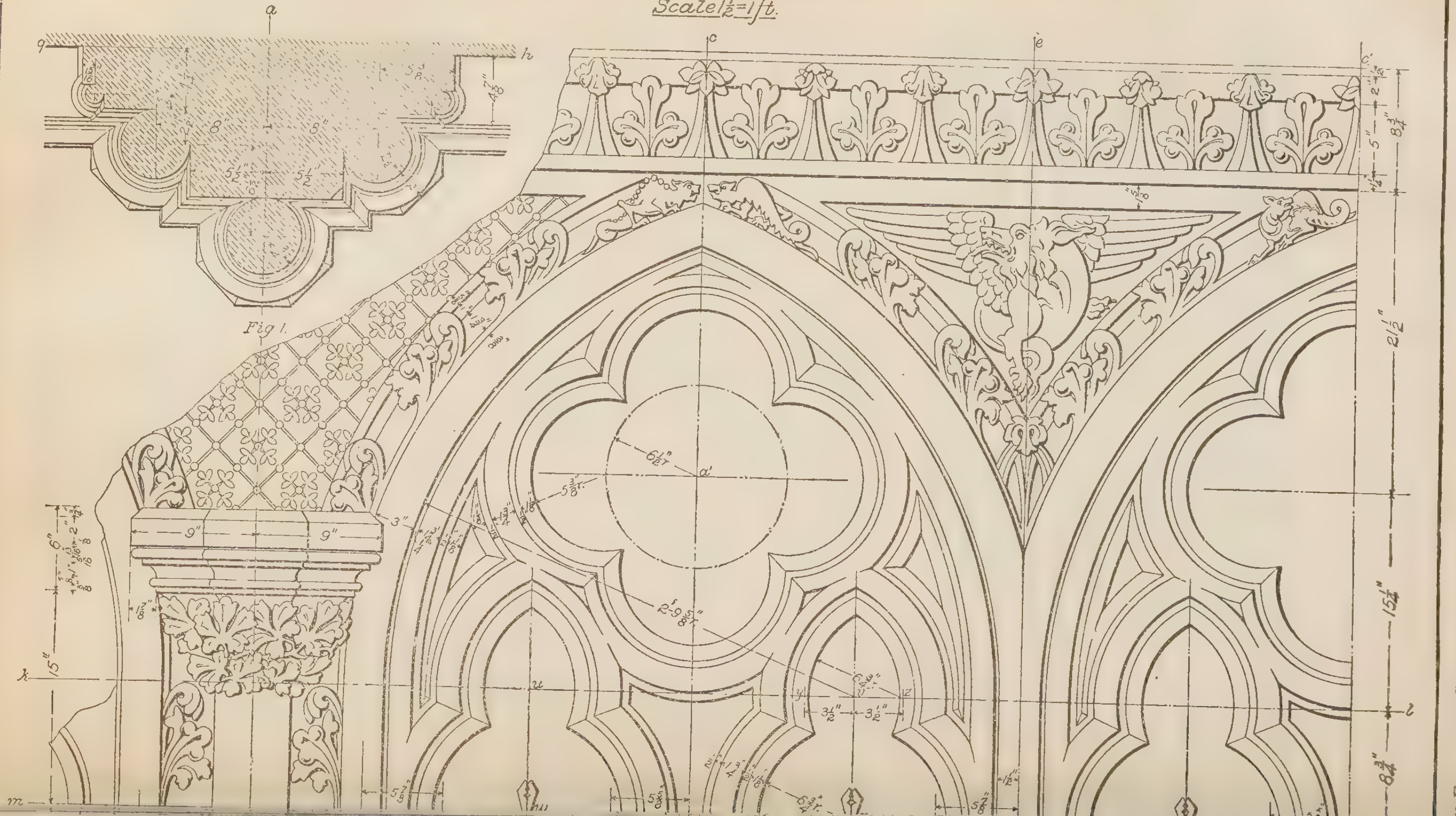
# GOTHIC ARCADE.

Scale $1\frac{1}{2}''=1$ ft.



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horizontal lines, and subdivide these principal divisions, defining the molded members and facias composing them.

From Fig. 1 project the pier and shaft lines to Fig. 2; from the lines just drawn, mark the limits of the bases of the shafts and profile the bases freehand. The upper portion of the base, marked *t*, is circular on plan, as shown on Fig. 1, while the plinth, marked *s*, is octagonal. As the outline of the lower section of the plinth is shown on Fig. 1, the angles can be projected therefrom. By drawing another line on the plan, nearer the center of the pier, and at a distance of $\frac{3}{4}$ inch from, and parallel to, the outline, the angles of the upper section of the plinth can be established, from which lines can be projected down to Fig. 2.

The diameter of the shaft, of which *e f* is the center line, being the same as that of the large angular shafts just drawn, the base and plinth lines can be transferred from it.

In order to draw the angular lines of the plinths under the $4\frac{1}{2}$-inch shaft, of which *c d* and *c′ d′* are the center lines, it will be necessary to draw a plan of the plinth under the elevation, locating the center of the shaft on the line *c d*; then with a radius of $3\frac{5}{8}$ inches draw a circle. From the same center, with a radius of $4\frac{3}{8}$ inches, draw a second circle; tangent to each circle draw a semi-octagon, the face of which will be at right angles to the center line *c d*; the angular lines on the elevation can then be projected from the plan so drawn.

Profile the moldings of the capitals, which are circular on plan, and of the impost blocks on the top of the capitals, which are octagonal on plan. First draw the projection of the top and bottom fillets on each side of the center line, from which the position of the other line can be determined; take, for example, the impost block of the shaft, whose center line is *c d*; at a distance of $5\frac{5}{8}$ inches each side of *c d*, draw the projection of the upper fillet; at a distance of $3\frac{3}{4}$ inches draw the projection of the lower fillet; then, with a center located on the line *c d*, describe two semicircles, each of which is tangent to one of the fillet lines just drawn; tangent to each semicircle construct a semi-octagon, from which the angular lines on the elevation can then be projected; the beads can then be drawn with the bow-pencil.

Now draw the main arches; at a distance of $11\frac{5}{8}$ inches each side of the center line *c d*, locate the centers *u* and *v* on the springing line *k l*, and draw the curves in accordance with the radii given. From the centers *u* and *v* draw vertical lines as shown; the intersection of these lines with the impost line *m n* will define the centers *w* and *x*; from *x* as a center, with a radius of $6\frac{3}{4}$ inches, draw a semicircle. Locate the centers *y* and *z* on the springing line *k l*, and from each center, with a radius of $6\frac{3}{4}$ inches, draw arcs intersecting the center line *v x* and also the circumference of the semicircle previously drawn. From the center *a′*, with a radius of $6\frac{1}{2}$ inches, draw a circle; the intersections of this circle with the vertical and horizontal lines drawn through its center will define the centers from which the cusps of the quarterfoil can be drawn; mark the width of the ribs and the members composing them, and draw the curves from the centers already determined, and complete the tracery.

Draw the recessed panels, or *niches*, between the shafts; locate the centers of the trefoil arch from the dimensions given, and draw the cusps, and the angle molds around same; draw the small molded gables, the inclination of which is 45° from the horizontal. Draw the angle shafts, with their molded bases and caps, from the dimensions given; the simple curves can be drawn with the bow-pencil, and the compound curves freehand. The sills of the niches have a sloping surface, on which the plinth blocks detail as shown.

Draw the molded cap of the central column on the large pier, of which *a b* is the center line; having drawn the profile from the dimensions given, draw a semi-octagonal plan by the process described for the octagonal impost block, and from this plan project the angular lines.

Locate the center lines of the *foliage* with which the molded string-course above the arches is decorated; draw the outline of one of the stalks; transfer the outline by means of tracing paper, and strengthen the lines.

Observe that there are three kinds of leaf clusters growing out of the stalks, those over the center lines of the main columns being similar, while the intermediate clusters vary in form. Sketch one of each style, and transfer its outline to the other stalks.

The leaf forms between the stalks are all similar, so that if one of them is sketched in correctly, a tracing can be made and transferred for the others.

Begin on the **diaper,** or surface ornament, in the spandrel on the left of the plate; to obtain the size of the squares, divide the vertical height into 15 equal parts, and make the squares occupied by the ornament equal to 2 of these parts.

Draw the grotesque figure in the spandrel of which *e f* is the center line, and also those adjacent to the apex of the arches. In order to keep the drawing clean and facilitate the process of inking in, the following method of developing the figures and foliage is recommended: Outline the space to be occupied by the subject, whether figure or foliage, on another sheet of paper; sketch in, at first faintly, with the light touch of a soft pencil, strengthening the lines as they assume the correct outline; when satisfactorily drawn, make a tracing and transfer to the drawing plate.

Having completed the figures, draw the *crockets* over the arches.

## DRAWING PLATE, TITLE: CLASSIC FAÇADE 1

**19.** This plate and the one which follows will constitute the **elevation of a classic façade,** suitable for an edifice dedicated to art and science, such as a museum, academy of design, technological institute, or some such establishment that tends to promote the educational interests of society, especially those that partake of an artistic, scientific, and literary character. The façade is composed of two Roman orders, the Ionic and Corinthian, details of which were given on previous plates, so that the student would the more readily realize the value of the parts when assembled in the general design. In order to obtain satisfactory results, the most accurate and careful attention must be given to the location of the center lines, the determination and drawing of the principal lines that define the divisions of the orders, as well as to the close observance and rendering of the minute details into which these divisions are arranged.

The ability acquired by the student in former examples can be evinced in the mode of executing this façade, and the value of precision, neatness in drawing, and due regard to the little things that the expert draftsman can only expect to realize by studious application, cannot well be better tested than by a comparison of the drawing with the plate.

This plate shows the first story, and is drawn to a scale of $\frac{1}{4}$ inch = 1 foot, but developed by a scale of modules. The second story will be given on the next plate.

The first story being designed in the *Roman-Ionic order*, the student is referred to the drawing plates entitled, Ionic Order and Ionic Details, for the measurements of the subdivisions.

Begin by drawing the center line *a b* at a distance of $8\frac{1}{2}$ inches from the left-hand border line; draw *c d*, the top line of the plinth, at a distance of $2\frac{13}{16}$ inches above the lower border line; then draw *e f*, the upper line of the entablature, at a distance of 26 feet 3 inches by scale above the line *c d*. As this vertical height defines the altitude of the order, which is equal to $22\frac{1}{2}$ m., the measurement of this module will be 26 feet 3 inches $\div 22\frac{1}{2} = 14$ inches, the unit for the proportional scale, by terms of which the elevation will be developed. Construct this scale by drawing a line $1\frac{1}{4}$ inches above the lower border line, and on it mark a point $5\frac{11}{16}$ feet from the left-hand border line; from this point mark a distance, by scale, equal to 19 m. in length, or 22 feet 2 inches.

Divide this distance into 19 equal portions, defining the modules, and subdivide the first one into 6 equal portions, each being $\frac{5}{30}$ m., or 5 p., which will be the *proportional scale* for the *Ionic order*.

The scale for the *Corinthian order*, which will constitute the second story of the façade, will be explained farther on; observe, however, that all measurements above the line *e f*

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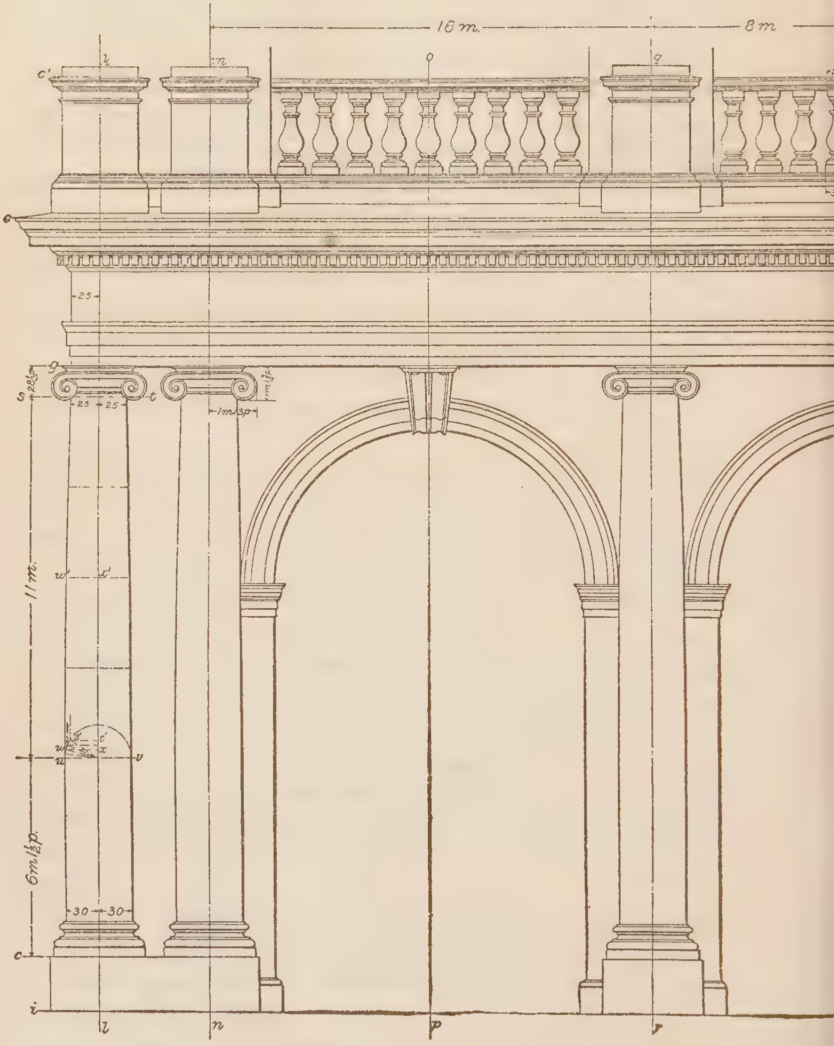

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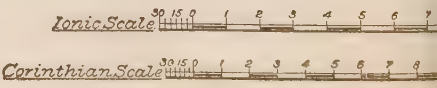

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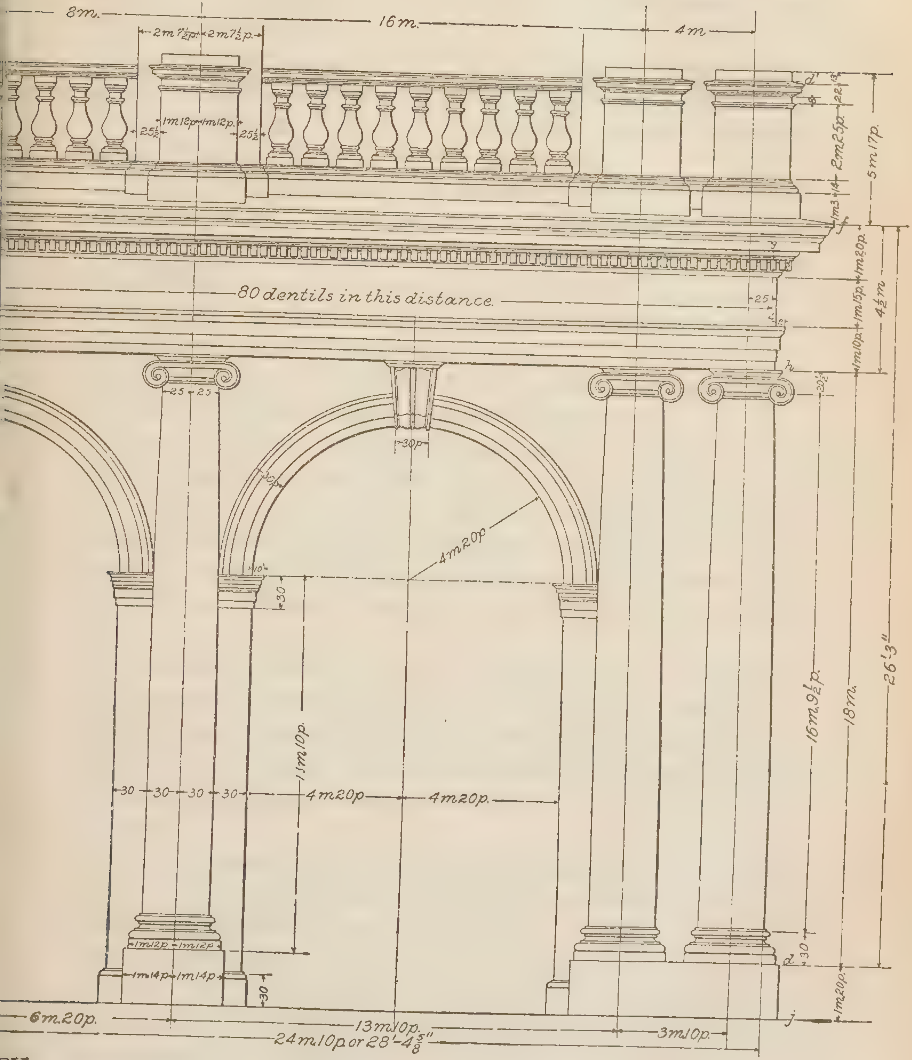

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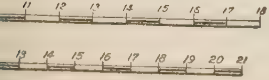

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are in accordance with the *Corinthian scale.* The regular scale of $\frac{1}{4}$ inch = 1 foot should now be laid aside, as the measurements hereafter given will be in terms of the proportional scale just drawn.

At a distance of $4\frac{1}{2}$ m. below the line *e f*, draw *g h*, the lower line of the entablature; divide the entablature into architrave, frieze, and cornice, as shown, and draw the horizontal lines.

Draw the horizontal line of the base blocks, or plinths, at a distance of 30 p. above the line *c d*, and draw *i j*, the floor line, at a distance of 1 m. and 20 p. below the line *c d*. Draw the vertical lines *k l*, *m n*, *o p*, *q r* parallel to the center line *a b*, and at distances apart equal to the measurements given to the right of the center line *a b*.

As the elevation is symmetrical on each side of the center line *a b*, the left half should be drawn first.

Commencing at the point of intersection of the line *e f* with the vertical center line *k l*, mark a series of points on the line *k l*, defining the vertical subdivisions of the cornice and architrave of the entablature and the capital and base of the column, procuring the measurements from the drawing plate entitled, Ionic Order; through these points draw horizontal lines.

Draw the profile of the base of this column, of which *k l* is the center line; then draw the profile of the entablature.

Draw the volutes of the capital freehand, first locating the projection and lower sides by the measurements given, the details being obtained from the drawing plate entitled, Ionic Details.

Draw the bases, shafts, and capitals of the columns of which *m n* and *q r* are the vertical center lines, and draw the plinth blocks under the bases of the columns.

At a distance of 11 m. 10 p. above the line *c d*, draw the springing line of the arches; then, from the point of intersection of each vertical center line between the columns with the springing line, and with a radius of 4 m. and 20 p., draw the soffit line of each arch.

On the springing line mark a series of points defining the widths of the members of the *archivolt*, locating them by scale measurements.

Draw these members, and locate and draw the keystones, the sides of which are radial lines; these keystones are capped with an abacus and worked like a console or bracket on the face, as they are in this position designed to give support to the entablature.

From the intersections of the soffit lines with the springing line, project the vertical pier lines. Mark the width of the impost blocks, which is 30 p., and divide them by scale measurements into facias and cap members, and profile them as shown, and draw the bases of the piers.

In order to draw the dentils of the bed mold of the cornice, first locate the dentil adjacent to, and also the one which projects beyond, the return line of the frieze; this should be done by reference to the drawing plate entitled, Ionic Details, which gives the accurate measurements. Draw $y z$, the center line of the second dentil from the return; divide the horizontal distance between the line $y z$ and the center line $a b$ into 80 equal portions; each division will be the center line of a dentil. To facilitate this process, the horizontal distance can be divided into 4 equal portions and one of these divisions subdivided into 20 parts, which can then be transferred to each primary division; as each dentil is 6 p. wide, one-half of this width, or 3 p., can be laid off on each side of the center lines by means of the dividers and the lines drawn.

By calculation it will be found that the groove between the dentils is very slightly in excess of that shown on the drawing plate entitled, Ionic Details, but this cannot be obviated in order to have the divisions close correctly. This difference, however, in practice, is indiscernible, as it is only .025 p., or about $\frac{1}{90}$ inch.

Having completed that portion of the elevation to the left of the center line $a b$, proceed with the development of the right-hand portion; this should be done before the balustrade over the cornice is drawn, as that portion of the elevation above the line $e f$ properly belongs to the second or superimposed order, and the measurements thereon given are in accordance with the scale of that order. As the superimposed order is the Corinthian, and is also developed by a scale of modules, it will first be necessary to draw this scale. The lower diameter of the column which rests on the pedestal is the same as the upper diameter of the Ionic column on the first story; therefore, the module, or semi-diameter, of the Corinthian column will be equal to 25 p. of the lower order. Construct this scale, drawing the lower line $\frac{13}{16}$ inch above the lower border line; draw the zero line, or the line marked *0*, immediately under that of the Ionic scale, and, as 10 modules on the Ionic scale will be equal to 12 on the Corinthian, project the division marked *10* on the Ionic scale down to the Corinthian scale, and mark it *12*; then divide the distance from *0* to *12* into 12 equal parts and complete the scale, as shown.

On the line *q r*, mark a series of points, defining the vertical divisions of the pedestal, and draw horizontal lines; the cornice and base lines of the pedestal also form those of the balustrade, which draw.

Draw the pedestal and pier lines to the left of the center line *a b*. In order to locate the center line of the balusters, which are each 1 m. wide at the base, mark a point on each pier 15 p. from the edge, and divide the distance between these points into 10 equal portions; the division lines will give the desired center lines for the balusters.

On the center line *a b*, which passes through the center baluster, mark a series of points defining the vertical divisions, and draw the lines; then profile the baluster.

The swell of the body can be drawn by means of the bow-pencil; the other members should be drawn freehand. Observe that the upper block of the baluster is 25 p. wide, while the lower block is 30 p. wide. Draw in all the balusters to the left of the center line *a b*; then draw the pedestals, piers, and balustrade to the right of the center line; indicate the position of the line *c′ d′* by a dotted line at each side of the façade, and complete the drawing.

## DRAWING PLATE, TITLE: CLASSIC FAÇADE 2

**20.** This plate shows the elevation of the **second story of the classic façade,** and is developed by means of the *proportional scale* for the *Corinthian order* on the previous plate. This story is designed in the *Roman-Corinthian order*, the details of which may be obtained from drawing plates entitled, Corinthian Order and Corinthian Details, to which the student is referred for the measurements of the subdivisions of the order.

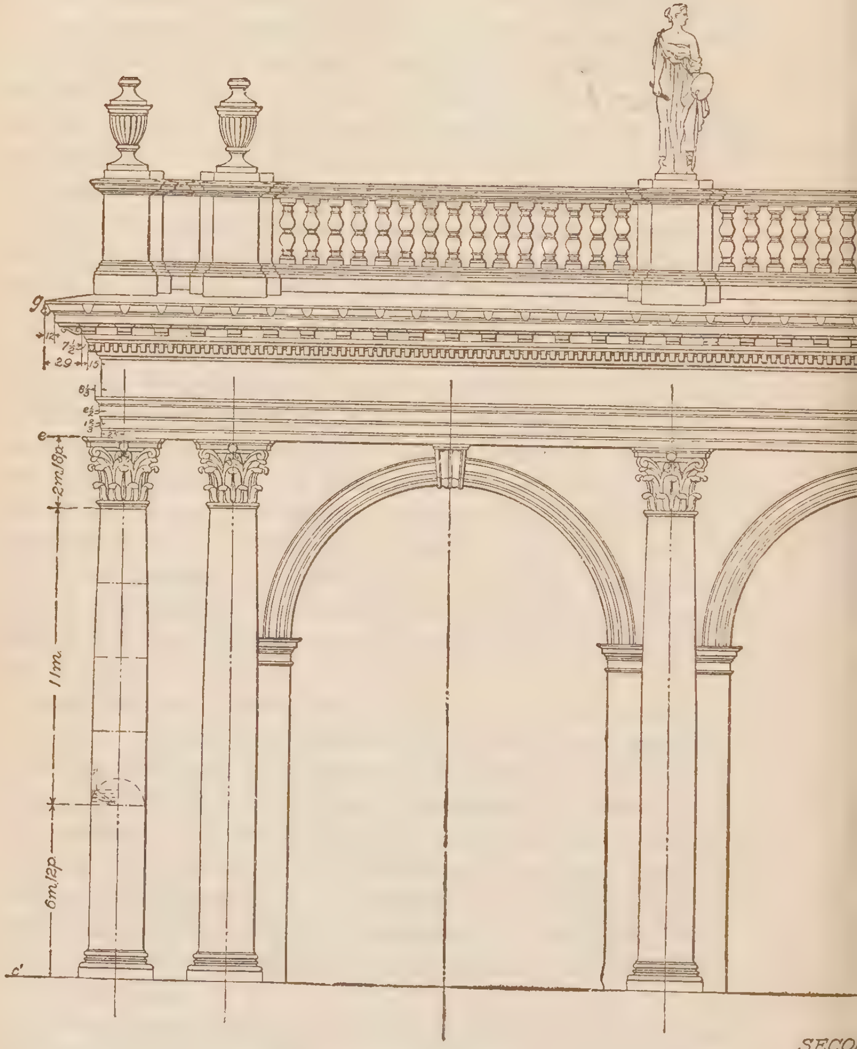
Begin by drawing the center line *a b* at a distance of $8\frac{1}{2}$ inches from the left-hand border line; draw *c′ d′*, the top line of the cornice of the pedestal (as shown on the previous plate), at a distance of $2\frac{1}{16}$ inches above the lower border line.

Transfer the position of the center lines of the columns from the previous plate by means of a strip of paper, locating the points on the edge of it by means of a needle, and puncture these points on the new plate, taking care that the center line exactly coincides, as upon this operation the accuracy of the work will depend, and as the plates may be united, as hereinafter explained, the slightest discrepancy will be observable. The façade being symmetrical, the left half of it should be drawn and completed before the other half is begun.

Draw the center lines of the columns and arches in accordance with the measurements given; draw *e f*, the lower line of the entablature, at a distance of 20 m. above *c′ d′*, and draw *g h*, the upper line of the entablature, at a distance of 5 m. above *e f*. From *e f* lay off a series of measurements defining the widths of the architrave, frieze, and cornice, and draw the lines; from the drawing plate entitled, Corinthian Details, procure the measurements of the subdivisions of these members, mark the points carefully, and draw the horizontal lines.

In locating the center lines of the modillions, observe that they should coincide with the center lines of the columns and arches over which they occur; the modillions are set at 40 p.

# CLASS



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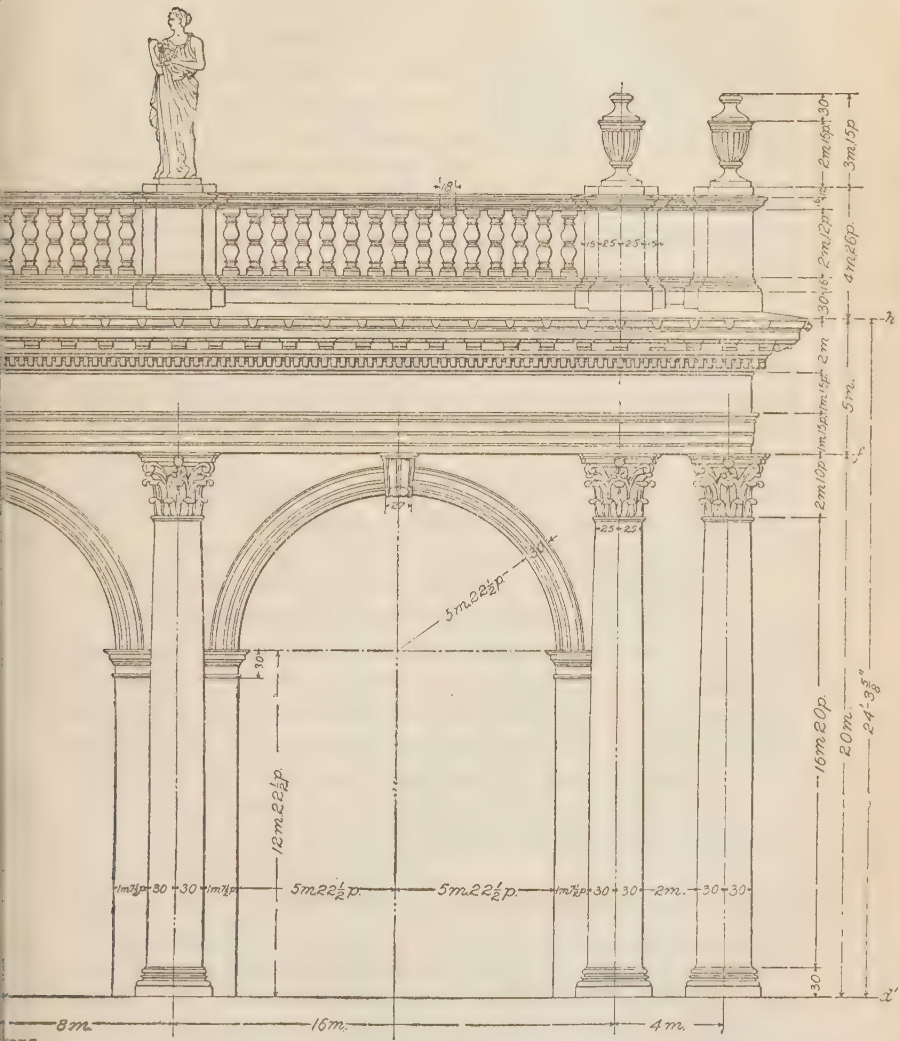

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between centers, and their widths should be marked by means of the dividers. Having drawn the modillions, locate the center lines for, and draw, the dentils, observing that there is a dentil immediately under each modillion; as the dentils are set at 10 p. between centers, the space between the center lines of the modillions should be divided into four equal portions, which will give the center line of each dentil. Draw the return of the entablature, making the various projections equal to the measurements given.

Sketch in the profile of the lion's head on the return, and also the blocks, defining the position of each head on the crown mold of the cornice, the centers being immediately over the modillions.

Lay off the measurements for the base, shaft, and capital of one of the columns, and profile them as shown. The entasis of the shaft should be drawn by the method given for profiling the shafts on drawing plate entitled, Corinthian Order.

The foliage of the capitals is drawn in block form, after the manner followed in drawing plate entitled, Composite Order. Draw one of the capitals, and transfer the leafwork, by means of a piece of tracing paper, to the others.

Draw the springing line of the arches, which is 12 m. and 22½ p. above *c′ d′*, and from the points of intersection of this line with the center lines of the arches, with a radius of 5 m. and 22½ p., draw the soffit line of the arches; on the springing line, lay off the widths of the molded members of the archivolt, and describe them from the same center.

Draw and profile the impost blocks of the piers on which the archivolts rest, and draw the keystones, which also serve as supports for the architrave.

From the line *g h*, mark a series of points on the center line *a b* defining the heights of the members composing the pedestals of the balustrade; viz., 30 p. to the top line of the plinth, 13 p. for the base mold, 2 m. and 18 p. for the height of the dado, 13 p. for the cornice of the pedestal, and 12 p. for the blocking course and the **wash,** or inclined surface of the cornice. Through the points marked, draw horizontal lines; subdivide the cornice and base members of the pedestal into molded parts, as shown, by scale measurements. Draw the vertical lines which denote the width of each pedestal and check-block of the balustrade, and profile the molded returns of the bases and cornices.

Locate and draw the center lines of the balusters, by the method given for those in the previous plate; divide the height of the baluster on the center line *a b*, by scale measurements, as shown, and profile its outline; the swell of the body may be drawn by means of the bow-pencil; the other members should be drawn freehand; when satisfactorily drawn, project the horizontal lines faintly across each panel and complete the balusters.

In order to draw the emblematic statues of Art and Science, first draw the center line, and mark the height of the figure by scale measurement; divide the height into 8 equal parts, and draw horizontal lines; one of these parts will give the height of the head.

On each side of the center line of the figure, draw vertical lines at intervals equal to those between the horizontal lines, thus forming a diagram of squares. Draw a center line through the figure on the plate, and divide its height into 8 equal parts as above; draw horizontal lines, and form a series of squares, as was done on the drawing; then observe where the governing lines of the figure on the plate intersect with the lines forming the squares; mark the relative positions of the intersections on the lines forming the squares on the drawing; then sketch in the outlines freehand.

Draw the vases which crown the angle pedestals in accordance with the figured dimensions, and complete the drawing.

As the width of the facade and the height of the orders were drawn to a scale of $\frac{1}{4}$ inch = 1 foot, even though the design has been developed by a scale of modules, still the dimensions of each and every part will have a relative value by the former scale which can readily be expressed in feet and inches, thus reducing it to a working drawing.

Thus, a measurement of 10 m. and 15 p. on the Ionic scale, the module of which is equal to 14 inches, will give

$10\frac{15}{30}$ m., or 12 feet 3 inches; and as 10 m. on the Ionic scale equal 12 on the Corinthian scale (from the fact that 25 parts of the Ionic scale was adopted as the module of the Corinthian scale), $11\frac{2}{3}$ inches is the value of each module of the Corinthian scale.

After the student has had his drawing corrected and returned to him, he may, if he so desires, mount the last two plates together, as one plate. If this is done, the last plate should be cut on the line *c′d′* and carefully attached at its proper level to the plate previously drawn, by a thin film of paste, which is preferable to gum, as it does not stain or discolor the paper.

# HISTORY OF ARCHITECTURE.

## ANCIENT ARCHITECTURE.

### INTRODUCTION.

**1.** Architecture had its origin in the efforts of man to provide for himself a means of protection from the inclemency of the seasons. At this period of the world's history, mankind was divided into but three general classes: hunters, shepherds, and agriculturists. The hunters dwelt mostly in rock clefts, or caves, while the shepherd pitched his tent wherever night overtook him in his wanderings with his flock; but the agriculturist became a permanent resident where he tilled his land, sowed his seed, and gathered his crops. Hence, we find different forms of habitations for different classes of people, which forms again vary in different climates and localities. In the agriculturists we find the nucleus of a community, and to this class we must look for the founders of a city and the constructors of permanent dwellings, of tombs and temples, and of other architectural edifices, which serve as monuments of instruction to future generations.

But *construction alone* is not *architecture*, for it may be found among the most uncivilized people; only when it is governed by systematic laws of proportion, which are based

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upon a refined conception of what is most suitable for the purpose, can construction be classed as a *fine art*. It is for this reason we find no architectural advancement in a nation until its condition betokens culture, wealth, and prosperity.

Buildings vary architecturally, according to the purpose for which they are erected, the locality in which they are built, and the historical period in which they are designed. The first two conditions will influence the *character* of the building, while the last will very largely determine its *style*.

A building is said to have *character* when its form and proportions express the purpose for which it is intended. Its *style* will depend largely upon the method of spanning its openings, such as doors and windows (whether with lintels, after the manner of the Egyptians and Greeks, or with arches according to the Roman custom), and also upon the formation of its roof. All architectural styles are based upon one or more of three general principles of construction: the **lintel**; the **arch**, or **vault**; and the **truss**. The ornamentation of a building is governed by the purpose for which the building is intended, the period in which it is built, and the character of the people by whom it is erected. We may say, therefore, that *the history of the architecture of a country is a history of the manners, customs, and temperament of its people.*

As tombs and temples form the principal structures from which we study the architecture of the ancients, one can readily see that *religion* is a most important factor in the development of architectural history. The civilization of Egypt was very different from that of Greece, but each possessed a polytheistic form of religion, and we find a great similarity in the arrangement of their temples; but owing to the difference between their conceptions of the immortality of the soul, we find a well defined distinction in the arrangements of their tombs and the methods of disposing of their dead.

With similar religious faiths we find similar systems of architectural design, and with dissimilar customs and habits we find a corresponding variation in some branch or detail of architectural arrangement peculiar to the customs of each individual people.

The dawn of Christianity was the advent of an entirely new style of architecture, and the division of the Church at the time of the Reformation was the signal for the alteration of this new style and the attempt to return to the old classic forms.

**2.** In the following pages on the styles and methods of different countries, observe how the *locality*, *climate*, and *temperament* of each people affected the contemporaneous architecture. Observe also how the religious fervor of certain classes expressed itself in every detail of their architectural monuments, and note carefully the decline in purity of style and nobleness of character, whenever the morals of a nation became lax, and worldly pastimes superseded proper religious thought.

## EGYPTIAN ARCHITECTURE.

**3.** For the beginnings of architecture we turn to Egypt, the cradle of the arts and sciences, where we find a reverential nation, who, believing in the resurrection of the body, embalmed and preserved with great care the remains of its dead. Its people built the pyramids as resting places for the bodies of their kings, and hewed immense temples out of the mountain sides wherein to worship their gods, while their dwellings, built of sun-dried bricks molded with clay from the banks of the Nile, were ephemeral structures, typical of a people who attached little importance to the details of their earthly existence.

**4.** The *pyramids* form a distinct class by themselves, and present no points in common with any other Egyptian structures. They are of gigantic proportions and were accounted by the Greek historians the first of the "Seven Wonders of the World." The Great Pyramid of Cheops, as seen in Fig. 1, was constructed with blocks of limestone, some of whose dimensions are so great that it is a mystery at the present day how they could have been quarried and transported with the primitive tools and machinery in use 3,000 years before the Christian era. This pyramid, about 800 feet square at the base, and 450 feet high, is *the largest structure in the world.* It is estimated that it took 100,000 men twenty years to build it, at a cost of over forty millions of dollars.

Next to the pyramids in massive grandeur comes the Great Sphinx at Gizeh. This is a statue of the Egyptian god Harmachis, carved out of solid rock, making a figure 146 feet long, 65 feet high, and 34 feet across the shoulders. The body, which has the form of a crouching lion, is now entirely buried in drifted sand, but the human head, measuring 28 feet from chin to top, and the broad massive shoulders, are still visible above the sand drifts, as shown in Fig. 1. Between the forefeet of the body is excavated a temple where the god was worshiped, and if built at the same time as the sphinx, this temple is the oldest architectural monument on record, as it antedates the pyramids over 1,000 years.

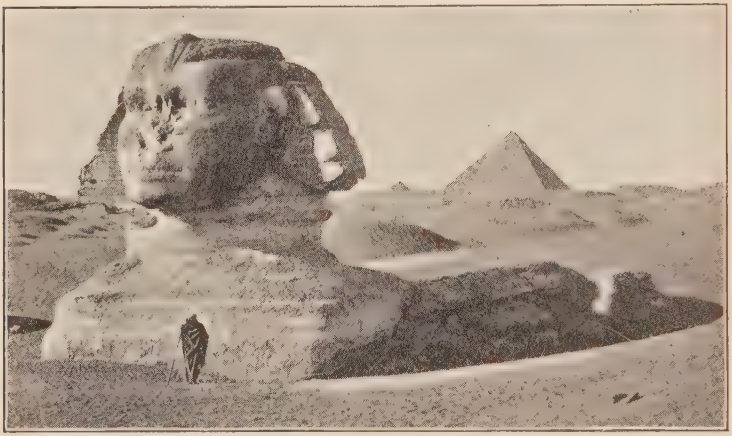

FIG. 1.

**5.** The most important architectural monuments of Egypt are its temples, and though they are very numerous and differ widely in size and elaboration of plan, the general scheme of arrangement is the same in all cases, whether the example is taken from northern Egypt or southern Nubia.

The Egyptian temple consisted of a small sanctuary, or *sekos*, as it was called, which was reached through a large **hypostyle,** or covered columnar hall, generally known as the "hall of assembly." Preceding the hypostyle hall was a large open courtyard, which was surrounded by high walls and entered between two tower-like front walls, called **pylons.** Each of these parts varied in its simplicity or complexity in different structures, but they are the essential features of all Egyptian temples, and may be traced out in every temple plan, no matter what may be their change of form.

Between the years 1600 and 1100 B. C., the greatest temples were built. The Pharaohs wanted eternal dwelling places for their deities, and built their temples entirely of stone, laid up in blocks so massive and so well fitted that they have withstood the ravages of time down to the present day.

**6.** In Fig. 2 is shown the plan of the Ramesseum, a temple built by, and named after, Rameses, one of the kings of Egypt, who reigned about 1500 B. C. Here the sanctuary is shown at *A*, surrounded by a number of smaller apartments *a*, which were used by the priests and members of the royal family, both as places for their mysterious devotions, and as royal residences; the king and his immediate relatives being

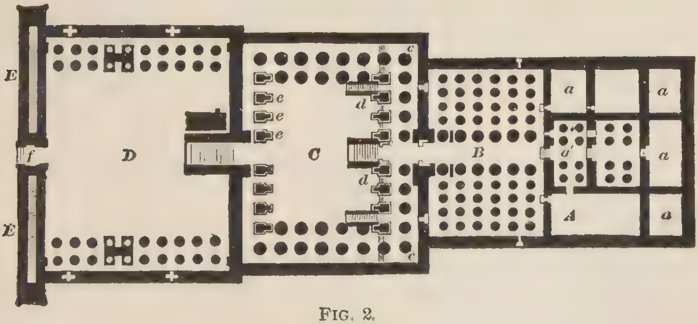

FIG. 2.

considered earthly representatives of the gods. The sanctuary contained the shrine, and was entered through either of two portals, one from the hypostyle hall *B*, and the other communicating with one of the sacred apartments *a'*.

At *B* is shown the hypostyle hall, the roof of which was supported by two sets of columns, the central ones being longer than those on each side, in order to provide a clerestory for the admission of light and air.

This is more clearly shown in Fig. 3, which is an illustration photographed from a restored model of the great hypostyle hall in the temple at Karnak. At *a* is seen the double row of long columns, which are connected longitudinally by the stone lintels *b*, in order to receive the edges of the stone slabs *c*, which form the roof over the *nave*, or central portion of the temple. On each side of these are the shorter columns *d*, which are connected transversely by the lintels *e*, and the inside row, longitudinally by the lintel *f*, to support the roof slabs *g* in the same manner as over the nave. An open space *h* is thus left to admit light to the interior of the

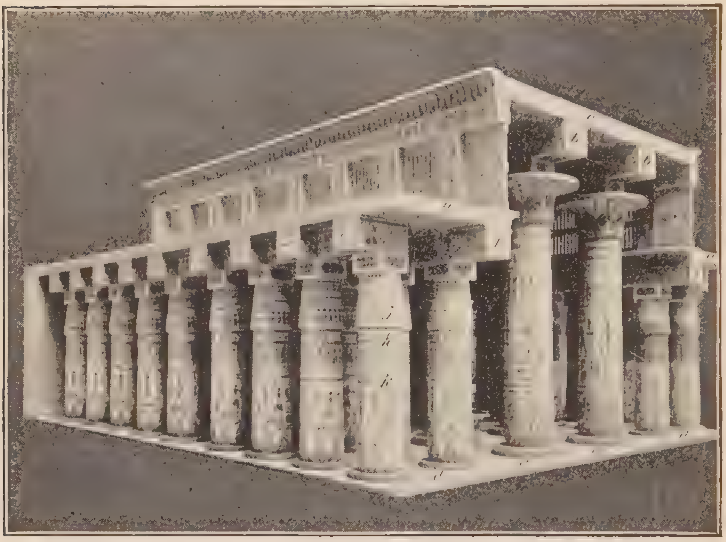

FIG. 3.

hall, and form a clerestory, similar to the same detail in our more modern cathedrals, of which we shall learn later on.

This system of supporting the roof is based upon the first of the three principles of construction referred to in Art. **1**; i. e., the lintel. The spacing of the supports being governed entirely by the length of lintel the builders were able to quarry, the columns are exceedingly close together, and this is the case not only in Egyptian structures, but in all architectural edifices, where the "lintel system of construction" prevails. For this reason, large apartments were never entirely roofed over in the Egyptian temples, but were open to the sky, either wholly or in part, as shown in Fig. 2 at *C*, which is the inner court of the temple, from which the hypostyle hall must be entered.

On each side of this inner court is a double row of columns supporting a roof extending from the side walls, while at the back is a single row of columns *c*, and a row of square piers *d*, which carry a portion of the roof which extends over from the hypostyle hall. Another row of square piers *e* carries the roof over the front end of this inner court, which, with the other partial coverings, surrounds the court with a narrow, projecting roof on all four sides.

The effect of this treatment must have been very imposing in itself, but, to add to the impression, colossal statues, such as shown in Fig. 4, were carved on the inside faces of the square piers, and flights of stone steps led up to a gallery at the level of the hypostyle hall, the floor of which was considerably above the level of the inner court. The outer, or entrance, court *D* was a comparatively plain enclosure, with columns on each side and a single flight of steps up to the floor of the inner court above. It was entered through a narrow portal *f* flanked on each side by the massive pylons *E*, and served merely as

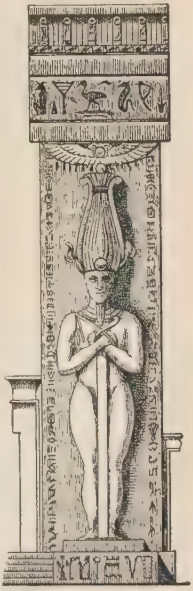

FIG. 4.

an entrance court preparatory to the grandeur and solemnity of the more sacred apartments beyond.

**7.** The *pylons* can best be studied from the exterior, where they appear to tower up with impressive dignity as if in forbiddance to any person unqualified to enter the precincts of the gods. The entrance was approached through an avenue, sometimes over a mile in length, lined on both sides with colossal statues of sphinxes or rams, as shown in Fig. 5. The walls of the pylons were richly decorated in colors, with hieroglyphical figures, the outlines of which were cut into the stone in order to render the design permanent, even after the elements had destroyed the effect of the color. On the inside, the walls were similarly decorated, so that the worshiper was everywhere confronted with the mysteries in which the ancient Egyptian religion abounded. Fig. 6 shows the outer court of the temple of Isis, on the island of Phylæ, somewhat farther up the Nile than the Ramesseum. Here on the right are seen the columns which support the roof along the sides, while in the center is the entrance through which the court is reached. To the left of

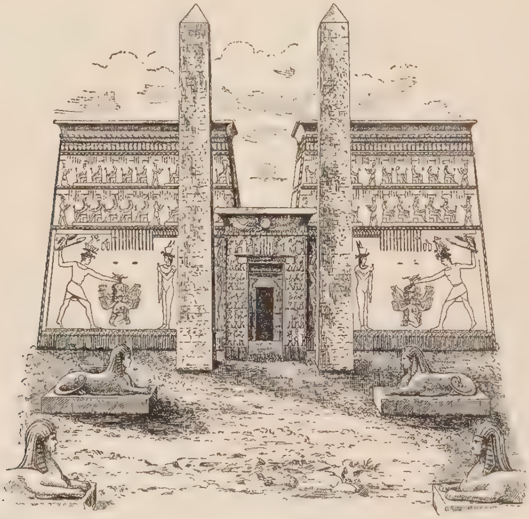

FIG. 5.

this main entrance is a smaller door, used only by the priests of Isis to enter some of the secret passages leading to other parts of the temple.

At the top the walls of the pylons flared out, forming a simple concave cornice, above which iron stocks carried gleaming cressets at night and flaunting banners by day, which, combined with the highly colored decorations on the walls, gave the building an effect of mysterious grandeur, perfectly consistent with the complex system of the ancient Egyptian belief.

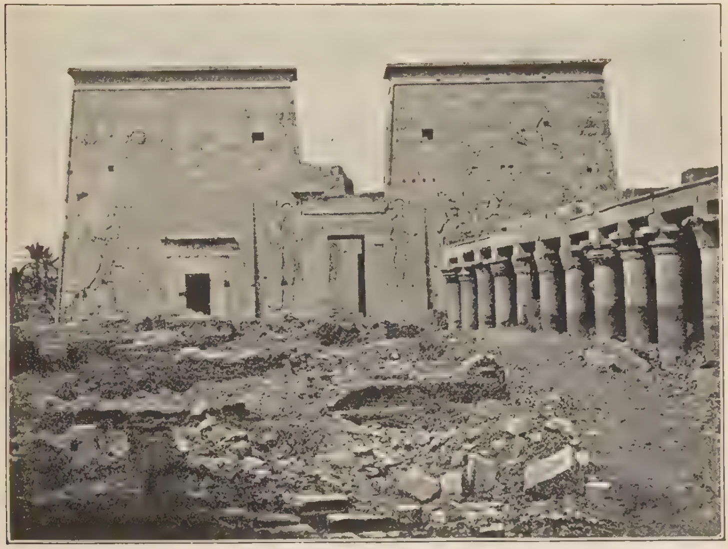

FIG. 6.

**8.** As we progress in the study of architectural history, we will find that, in religious edifices, the aim of the designers has always been to create in the building an impression of grandeur, dignity, and awe. In Egypt the worshiper entered the temple after traversing the long avenue of sphinxes. Passing between the towering pylons, he found himself in the large outer court, which was brilliantly illuminated by the vertical rays of the tropical sun. He then ascended the stairs to the inner court, which was smaller and partly shaded by the projecting roof. In this shade he laid his offering of fruit or grain, at the feet of one of the graven images described in Art. **6,** and then in solemn silence ascended to the gallery and entered the dimly lighted hypostyle hall to receive from the priest the acknowledgment of his offering to the gods. If he was an Egyptian of high caste, he might then proceed farther, to one of the sacred apartments beyond the hypostyle hall, or even to the sanctuary itself, but if not of royal birth his pilgrimage ended in the hypostyle hall, from whence he retraced his steps or departed from the temple through a side door provided for the purpose.

The numerous temples throughout Egypt varied in size, but the essential features remained the same, and the variation consisted principally in the addition of chapels and royal apartments around the sanctuary, while the sanctuary itself remained about the same, being one of the smallest apartments in the temple.

The great temple at Karnak, erected 1500 B. C., was 376 feet wide, 1,215 feet long, and covered over 400,000 square feet of ground—twice the area of St. Peter's Church at Rome (the largest building now existing)—but contained a sanctuary only 16 ft. × 26 ft., the area of which was only a little more than the space occupied by one of the great columns of the hypostyle hall, which were 21 feet in diameter. The Ramesseum, shown in Fig. 2, was much smaller than the temple at Karnak, being 182 feet wide and 590 feet long.

**9.** To the early inhabitants of Egypt, who dwelt in caves, we are indebted for the origin of the rock-cut temples. These excavated worshiping places have little architectural interest in themselves, but serve to illustrate most forcibly the temperament of this ancient Egyptian people, who toiled patiently and almost unceasingly to excavate in the mountain side a temple that should be as permanent and enduring as the mountain itself.

Fig. 7 shows the plan of a rock temple at Ipsamboul, while Fig. 8 shows its longitudinal section. The entrance is guarded by four colossal statues of King Rameses II, as shown in Fig. 9, and at *a* in Fig. 8. These statues represent the king in a sitting posture, and are $68\frac{1}{2}$ feet high, and carved in the native rock of the mountain side. The general arrangement of the excavated temples is similar to that of the ones above ground. A covered vestibule hewn out of the rock forms the entrance, as shown at *a* in Fig. 7, which opens into a hall *b* that corresponds to the inner court of the open temples, as shown at *C* in Fig. 2. Beyond this is located a smaller chamber *c*, similar in position to the hypostyle hall, where columns or piers are introduced, according to

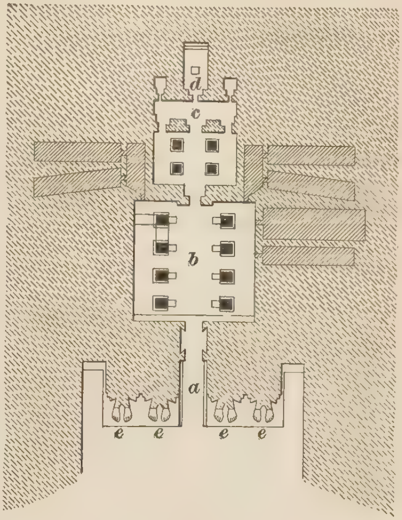

Fig. 7.

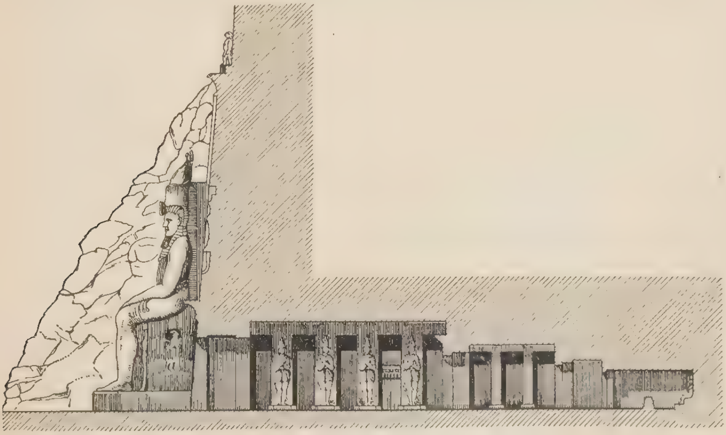

Fig. 8.

circumstances, and at *d* is excavated the sanctuary accessible to none but the priests and king. The walls, architraves, piers, and columns are always richly decorated with sculptured or painted ornament, similar to the decorations on the walls of the open temples. In these decorations the winged globe occurs very frequently, especially over entrances and on entablatures. This consists of a globe or disk, emblematic of the sun, on each side of which is a spread wing. The winged globe is used frequently in Egyptian hieroglyphics to represent immortality or divinity, and sometimes as the emblem of sovereignty in the sense that the kings were the earthly representatives of the gods.

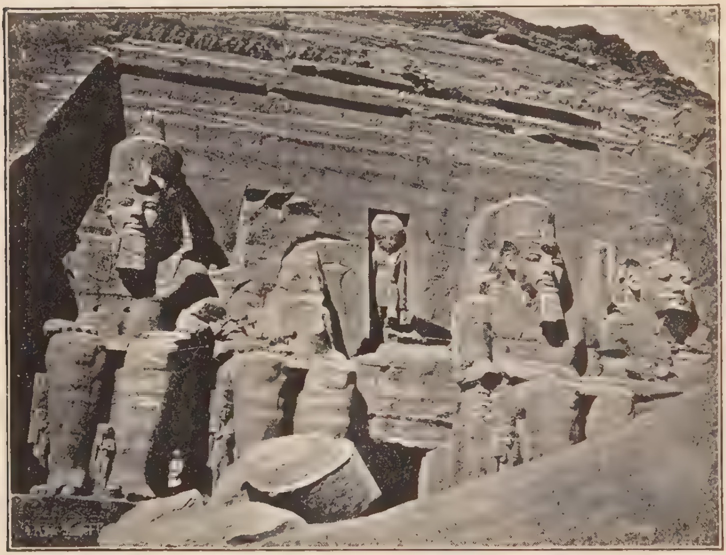

FIG. 9.

**10.** The roofs were supported on piers or columns, the earliest form being a quadrangular pillar with parallel or slightly inclined sides, without either base or capital; this form occurs in the most ancient tombs, though it may be found later in the temples at Karnak and at Medinet Abou. The sides of these square columns are often covered with painted scenes; the front is usually sculptured, sometimes with a head, and at other times with a full-length figure of Osiris, the god, who, according to Egyptian Mythology, represented the beneficent power of nature, and was supreme judge of the dead. Fig. 4 shows one of these square columns, in the temple at Medinet Abou, and is a type of them all, though the details of the figure may vary slightly in different examples.

By cutting off the corners of these plain square pillars, we make an eight-sided column, and then cutting the eight new edges, a column with sixteen sides is obtained, as in the processional hall of the great temple at Karnak. In this same temple we find columns with thirty-two sides, the arrises, or meeting edges, of which are emphasized by making the sides slightly concave. The addition of a large square slab on the top gives us the form of column used in the facade of the tombs at Beni Hassan, erected 2000 B. C., as shown in Fig. 10, and this column is of vast importance in architectural history, as it is undoubtedly the prototype of the *Grecian Doric*, of which we shall learn more later on.

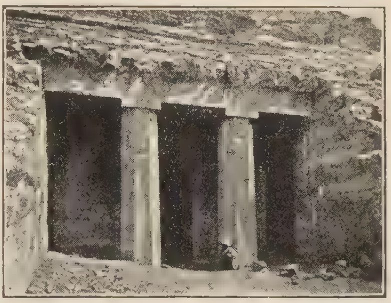

FIG. 10.

**11.** Subsequently the column became perfectly round, and tapered towards the top, where it spread out into an enormous bell-shaped capital (therefore called **campaniform**), carved and painted to represent the full blossom of the lotus flower, as shown at *i*, Fig. 3. The edge of the shaft at the bottom was sometimes rounded off and decorated with a pointed ornament representing the large leaves around the sprouting lotus, above which to the top of the column would be engraved hieroglyphic inscriptions or bas-reliefs, as shown in Fig. 3. The corners of the four and eight sided columns were sometimes rounded off, while the plain sides were reeded, thus giving the appearance of a bunch of stems. These stems were finished with a clustered row of *lotus buds* under the capital, as at *j* in Fig. 3, and were ostensibly held in place by a number of bands, as at *k*. The capital was narrower at the top than at the bottom, and its surface was sometimes reeded like the shaft, or painted on a smooth surface to represent the reeds. Such columns are called **lotus-bud** columns.

Another form of column had a square cubical block for a capital, the upper portion of which was designed to represent a *naos*, or cell, similar to the sanctuary, with a miniature entrance and propylon on each side, under which were carved heads of either that of Hathor or Isis, the former the Goddess of Love, and the latter the Goddess of Fecundity and consort to Osiris. These columns are known as **Hathor-headed** or **Isis-headed,** as the case may be, and are as shown in Fig. 11, which is a portion of the Temple of Hathor at Dendarah.

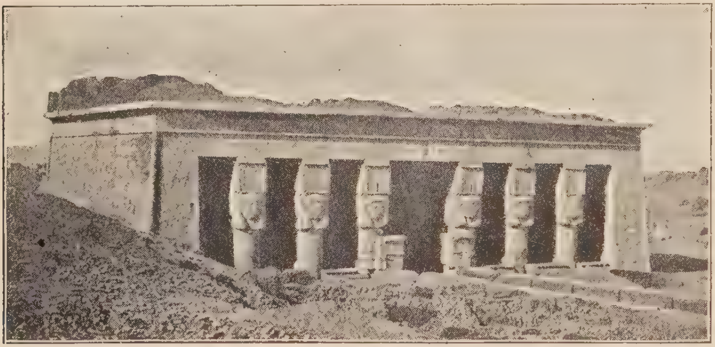

FIG. 11.

Fig. 12 shows a restoration of one of these columns, from which the details may be more clearly understood. In the architecture of Egypt, there are no established rules of proportion. The height and projection of the capital bear no fixed relation to the length or diameter of the column, as do these details in later architectural styles, and the construction being almost entirely of stone, the columns were placed very closely to receive the lintels and slabs that formed the roof.

**12.** The distinguishing characteristics of the Egyptian style may be summed up as follows: massive tapering walls, surmounted with a great cavetto cornice; short, thick, closely spaced columns with the lotus-flower capitals; prolific decoration in bas-relief, and hieroglyphic painting; colossal figures of human beings, sphinxes, and the obelisk. The general appearance and effect of Egyptian structures was that of solemn grandeur, which, in their temples and tombs, seems to have been pervaded with a deep sepulchral gloom, fittingly symbolizing the mystic character of the religious belief which this ancient people respected.

While the Egyptians made use of the *arch* in some of their minor constructions, it never appears as an *architectural feature* in any of their works. All openings were spanned by *lintels*, and the vaults and arches that did exist were mostly produced by *corbeling* each course of stone beyond the next one below, and not by means of **voussoirs,** as the wedge-shaped stones in the circumference of an arch are designated.

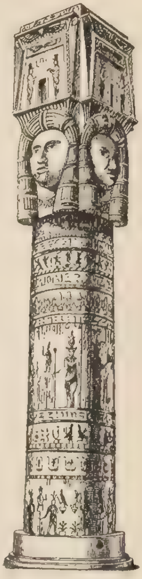

FIG. 12.

The importance of this will be better understood by the student later on, when we study the structures erected under the second principle of architectural style described in Art. **1**; **i. e.**, the arch.

## ASIATIC ARCHITECTURE.

### CHALDEAN AND ASSYRIAN ARCHITECTURE.

**13.** Although the architecture of western Asia is of little importance so far as its direct influence on subsequent styles is concerned, a certain amount of consideration must be given it in order to preserve the thread of chronological architectural history.

The civilization of the valley of the Tigris and Euphrates rivers was next in antiquity to that of Egypt, but was far inferior to that country in art and architecture. The subjects of the two kingdoms, Chaldea and Assyria, which ruled this valley, differed widely in character and culture, but the lack of good building material and the flatness of the country imposed on both nations similar restrictions of conception, form, and material. Not a tomb or a temple of these ancient nations stands today to enlighten us on the details of their systems of construction, but the remains of their palaces, especially those of Assyria, show a scale of magnificence that is simply astounding, though, owing to the lack of good building stone, these palaces were erected of brick, the poor quality of which prevented the builders from carrying their structures to any great height. Elevation above the level plain of the valley was, therefore, attained by first erecting immense terraces, or mounds, which were faced with stone slabs or hard burned brick, and on these mounds buildings of moderate height were erected. The absence of stone suitable for columns, and the difficulty of procuring beams of long span, made broad halls or large covered rooms practically impossible. The plans of these palaces, therefore, consisted of a series of long corridors and small cells, and no column or post was used anywhere, except occasionally as a window mullion. What these buildings lacked in durability, however, they made up in magnificence. The interior walls were wainscoted to a height of 8 or 9 feet with alabaster slabs richly carved in low relief to represent hunting scenes, battles, tribute to the kings, and glorification of the gods. Plastered walls were painted in brilliant colors, and every art known to these people was employed to make their palaces a maze of richness and architectural splendor.

The system of construction was simple. The clay walls, faced with alabaster slabs, enameled tile, or hard burned brick, were roofed over with cedar beams, or sometimes paved with tiles to form terraces. Light was admitted through small windows immediately under the roof, and certain rooms in the interior of the palace were entirely windowless. Even at the present day the inhabitants of these districts take refuge from the torrid heat of the summer midday in windowless apartments, lighted only by lamps. The above facts are obtained more from the frescoes and wall decorations, than from any details of buildings which still remain. These decorations are of little interest to the architect, except where they do represent some ancient system of construction. Above the wainscots which line the courts and corridors, were wide friezes of enameled brick, richly ornamented with various symbolic forms, used as decorative motives. Of these the most frequent were "the sacred tree," the winged bull, and other mythological monsters, together with palmettes or fan-shaped floral designs, and the lotus blossom. The latter, which were used largely around the archivolts over the arched entrance gates, were probably derived from Egypt. The most characteristic adornment of these entrances were the "portal guardians," set into deep jambs. These were colossal monsters with human heads, and eagles' wings, and the bodies of bulls. Though of tremendous proportion, every part was minutely wrought, even to the details of the head dress, the hair, the feathers of the wings, and the anatomy, as shown in Fig. 13.

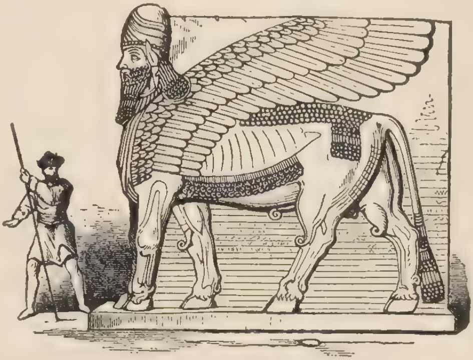
FIG. 13.

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### PERSIAN, LYCIAN, AND JEWISH ARCHITECTURE.

**14.** When the Persians conquered the Tigro-Euphrates Valley, a most important change took place in architectural history. This nation was of an entirely different race from those whose buildings we have so far considered, and consequently it stamped the architecture which it borrowed from the Assyrians, with new forms and details, expressive of the extreme difference in the manners, customs, and temperaments of the two peoples. The Egyptians, Chaldeans, and Assyrians were of the Semitic race, supposed descendants of Shem, the eldest son of Noah, while the Persians were of the Aryan race, which was the stock from which all European people, with the exception of the Turks, have descended. The conquering nation was one of warriors, and had little artistic taste. They had overthrown the Egyptians and Assyrians, but were themselves conquered by the arts of their vanquished foes, and soon became the most luxurious of nations. The Persians possessed few original artistic forms, but coming from a part of the country that was rich in building material, they were able to combine the Egyptian system of interior columns with the elaborate decorative details so prominent in Assyrian art. Owing to the abundance of fuel in Persia, this nation used burned brick much more freely than was practical in Assyria, and their structures, thereby rendered more enduring, are sufficiently preserved to give us at the present day a very fair idea of what they were like. Stone was also used for walls and columns, and in conjunction with hard burned brick formed the jambs of doors and windows, while the archivolts or lintels and the ceiling beams were always of wood. The Persian palaces were erected on broad platforms or terraces, in the same manner as those in Assyria, but unlike the latter, they consisted of numerous detached buildings, entered through magnificent portals and gates of honor which lead to immense audience halls open on one or two sides, around which were grouped the chambers or dwelling apartments, either attached or in separate buildings. Persians, being worshipers of fire and the sun, conducted most of their devotions out of doors, and for that reason temples seem to have been of little importance, and structural tombs existed only for the reception of the royal dead.

**15.** Like the Egyptians, the Persians used columns as an internal feature in the construction of hypostyle halls of great size, and externally in their porches and kiosks, or open pavilions. The great hall of Xerxes at Persepolis covers over one hundred thousand square feet, more than double the area of the hypostyle hall at Karnak, but the Persian column derived from a wooden prototype and used with a wooden lintel, permitted a much wider spacing than was possible in the stone construction of Egypt. In the hall of Xerxes, thirty-six columns were used to support the roof over the same area for which one hundred and thirty-four columns were used in the temple of Karnak. The shafts were slender and finely fluted, instead of being painted or carved, and the effect produced was totally different from that sought by the Egyptians. The capital of the column was its most striking peculiarity. It was forked at the top, each half being carved to represent the forepart of horses, bulls, or mythological monsters, as shown at *a* in Fig. 14, which were supported by a combination of vertical scrolls or volutes, as shown at *b*, resembling certain ornaments seen in Assyrian furniture. Below these, the column was carved somewhat like a double bell, as shown at *c*. This column and capital supported two pairs of architraves, or lintels, one of which rested on the heads or backs of the carved horses, as shown at *d*, while the ends of the others rested in the fork between them, as at *e*. A rich molded base supported the column, which was usually carved with leaves or flutings.

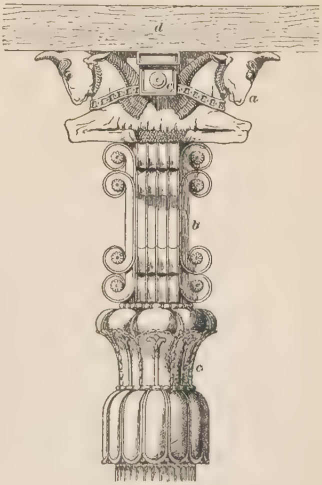

FIG. 14.

The Persian capital is unique. It has no direct prototype, yet details of many other forms may be seen in its design. In it the Egyptian capital is suggested by the bell shape at *c*, but the scroll ornament *b* is undoubtedly of Assyrian origin, while the carved monsters at the top are of the same type as the Assyrian bull, shown in Fig. 13, but are more architectural in their position on the capital, as they form a structural part of the building and really assist in holding it up. This is very important in the study of architectural development, as it shows a tendency towards the improvement in architectural construction which culminated in Greece, where it attained perfection.

The doors and windows of the Persian palaces had banded architraves and cavetto cornices strongly suggestive of Egyptian origin. The portals were flanked, as in Assyria, by winged monsters, which, however, were built up in courses of stone, instead of being carved from single blocks like their Assyrian prototype. The alabaster wall finish of Assyria was, in Persia, replaced with plaster or enameled brick; the latter being of brilliant colors and molded into relief pictures covering large surfaces. This enameled brick is the oldest example of the skill of the Persians in a branch of ceramic art in which they have excelled the world down to the present day.

**16.** The architecture of the Asiatic people which served intermediate between the ancient civilizations of Egypt and Assyria and the more modern civilization of Greece, plays no important part in architectural history. The Greeks adopted many of their forms from the Phenicians and Lycians, but these forms had come originally from Egypt and Assyria. The Phenicians were traders, and in bartering for the manufactures of Egypt and Assyria, they naturally carried certain art forms which influenced subsequent architectural history. The Lycians had no architecture of their own, except a form of tomb design, which came near creating a new architectural style, and which doubtless influenced both Persia and the Ionian colonies.

**17.** The Hebrews borrowed from the art of every people with whom they had relations, so that we encounter in the few remains of their architecture now existing, Egyptian, Assyrian, and Phenician forms, but nothing like a national style. The general trend of their designs was Egyptian in character, and for the description of their temples we have to depend very largely on scriptural writings. The one great achievement in Jewish architecture was the national Temple of Jehovah, represented by three successive edifices on Mt. Moriah. The first one, built by Solomon, 1012 B. C., appears, from the Biblical description, to have combined lofty entrance pylons, successive courts, and the sanctuary, or sekos, of the Egyptian temple, with cedar woodwork, repoussé metal work, and isolated brazen columns of the Phenician and Assyrian styles. This temple was nearly doubled in size by Herod in 18 B. C., who extended it southward by a terrace wall of still more colossal masonry. Some of the stones were 22 feet long, and one reached the prodigious length of 40 feet, which sizes are suggestive of Egyptian origin. The site of this temple is now occupied by the Turkish Mosque of Omar. Nothing remains of the original building except a masonry wall, now known as the "Wall of Lamentations."

## GRECIAN ARCHITECTURE.

### PELASGIC PERIOD.

**18.** Greek art marks the beginning of European civilization. This nation situated on a peninsula and cluster of islands, in the Mediterranean Sea, was engaged in an extensive trade with the nations of western Asia and northern Egypt. From each of these people the Greeks received ideas which they combined and embodied in their architectural monuments, but they effected this combination only after carefully analyzing the forms they borrowed, so as to understand their structural importance and preserve their artistic effect. The first record we have of any colonization on the shores of Greece is about the year 1800 B. C., when a tribe of savages, known as the Pelasgi, landed there from Syria or Asia Minor. The Pelasgi founded cities and remained undisturbed in the possession of their adopted country for about three hundred years, when they were conquered by the Hellenes, a nation also of Asiatic origin, but far more civilized than the Pelasgi.

**19.** The few architectural monuments now standing, from which we can judge of the art and skill of this prehistoric nation, consist of massive walls, built of huge pieces of roughly hewn stone laid up together without mortar of any kind. The immense proportions of these stone blocks suggest that the method of their quarrying was derived from Egypt, while the shape of the openings in the walls produced by corbeling each successive block slightly beyond the next one below, was probably derived from some of the structures observed in Asia.

The Greek historians looked upon such achievements in construction as something beyond the power of ordinary men, and declared these walls to have been built by the *Cyclops*, a mythical tribe of giants; and to work of this character the Greek legends ascribe the name of **Cyclopean** masonry. Fig. 15 shows the general appearance of these Cyclopean walls as they are at the present day, after surviving the disintegration of centuries.

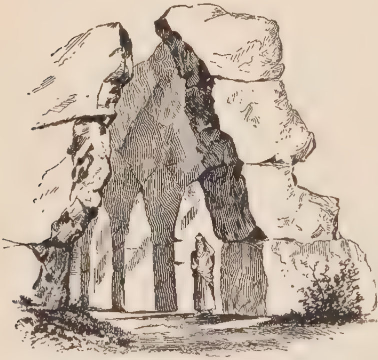

FIG. 15.

The system of construction here must still be classed with the lintel, for although the openings are closed at the top in the form of a pointed arch, that form is attained through the narrowing of the opening by the projection of each successive course of stone beyond the one next below, depending upon the preponderance of the mass over the bearing, to prevent the block from toppling over into the opening, while the top is closed by a single stone lintel or slab. This system is somewhat more clearly shown in their tombs, the most important of which is shown in Fig. 16. This figure illustrates a section through a tomb known as the Treasury of Atreus, built at Mycenæ. The entrance *a* opens into a domed chamber, the form of which is circular in plan, while the side walls are corbeled over to make a pointed dome. At *b* is a passage through the wall to the vault *c*, which is excavated in the solid rock, similar to the rock-cut temples of Egypt. The passage *c* is corbeled over to a pointed arch similar to those in Fig. 15, and the whole exterior is covered with earth to hide all from view, except the narrow entrance *a*. These tombs were called *treasuries*, because it was a custom of the people to deposit in the vaulted chambers valuable chalices of gold, silver, or bronze, together with coins, and pottery, etc., all of which was considered to be of great importance to the dead hero in the vault, in order that he might be prepared to awake and sup with the gods.

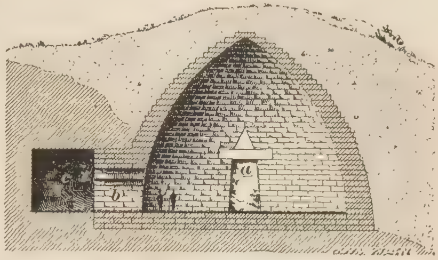

FIG. 16.

These tombs or treasuries are of importance to the architect, however, only as far as they illustrate the system of construction, and thereby preserve the thread of history, from a similar system which preceded, to an advanced system which followed.

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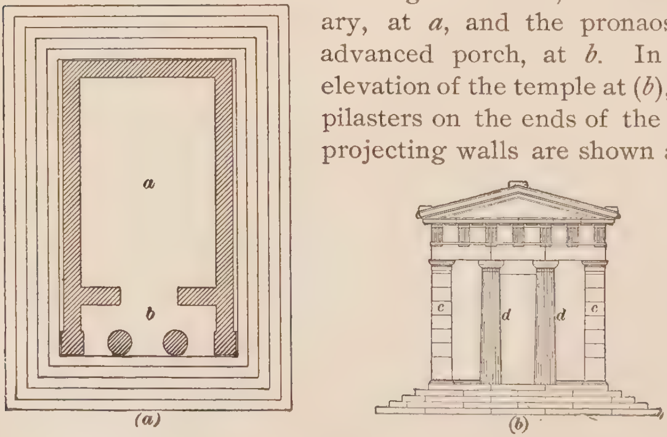
### PERICLEAN PERIOD.

**20.** The age of Pericles, or the period in which this greatest statesman of Greece held power, marks the dawn of architectural perfection. The architecture of the Egyptians, Assyrians, and Persians, though important in the preservation of the thread of history, has exercised but little influence upon the art of the Western nations, but the influence of this period of Grecian art pervades all subsequent architectural history.

Greek architecture reached its full development in temples, and though we can still study the remains of theaters, circuses, market places, and tombs, it is in the Grecian temple we find that perfection of detail which has made Greek art immortal. Unlike the Egyptian temple, designed entirely for internal effect, and built with an extravagance of material, and a preponderance of strength in every detail that was awe inspiring, the Greek structure appealed far more to the admiration of the bystander on the outside than to the worshiper within. A parallelogram in plan, with columns at each end or entirely surrounding it, the Greek temple was a small structure with a simple naos, or cell, enclosed within four masonry walls.

**21.** The earliest temples consisted of a naos only, and were *astylar;* that is, without columns at all, except sometimes on the front, where a *pronaos*, or porch, was produced by continuing the side walls beyond the front wall of the temple, and placing the columns in *antis;* that is, between the two pilasters forming the ends of the projecting walls, as shown in Fig. 17, in which (*a*) is the plan of the temple, showing the naos, or sanctuary, at *a*, and the pronaos, or advanced porch, at *b*. In the elevation of the temple at (*b*), the pilasters on the ends of the two projecting walls are shown at *c*,



(*a*) (*b*)

FIG. 17.

and the two columns, *in antis*, between them are shown at *d*. The next step in temple design was to advance the porch entirely beyond the front wall of the building, and support its roof with columns on three sides, converting it into a *prostyle temple*, or one with a projecting line of columns; or when both ends of the building were thus treated, it became *amphiprostyle*, i. e., prostyle at both ends, the *sides* still being astylar. Next, the columns were continued all around, enclosing the naos with a colonnade on all sides, and the temple became *peristylar*, i. e., surrounded by columns. Should there be a double row of columns all around, the temple was called *dipteral.*

**22.** The internal arrangement of all Greek temples was extremely simple, as shown in Fig. 18, which is the plan of the Parthenon at Athens, the most celebrated of all Greek temples. At *a* is the platform surrounding the building on which the columns rest, *b* is the pronaos, or porch, immediately in front of the entrance to the naos, or cell, *d*. At *e* is the *opisthodomus*, or treasury chamber, where the gold and silver chalices, urns, torches, and braziers, employed in various ceremonies, were stored when not in use. At *c* is the rear porch, or posticum, in front of the door of the treasury chamber. From this plan and arrangement it will be observed that the Parthenon was symmetrical; that is, its two ends were precisely alike, and also its two sides, a system of design that, with one exception, is characteristic of all Grecian temples.

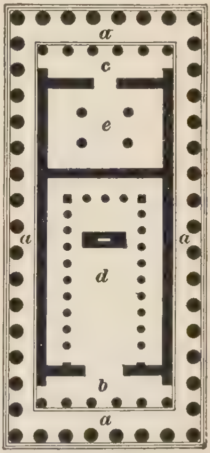


FIG. 18.

**23.** The architecture of the Greeks, like that of the Egyptians, was essentially a columnar system of building, though, in marked contrast to the latter, the columns were entirely on the outside of the Greek temple, while in Egypt these supports existed only within the massive walls. The

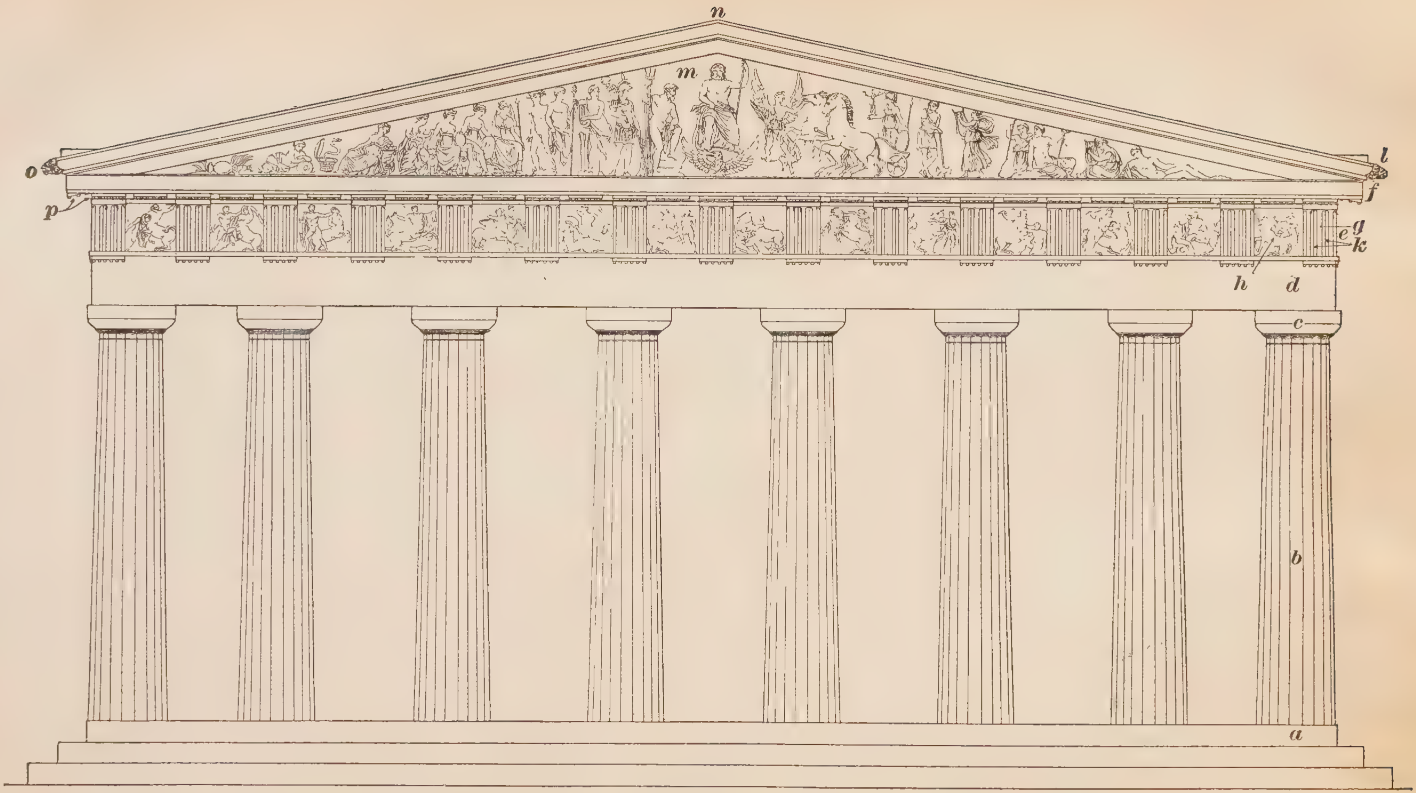


FIG. 19.

columns in Grecian architecture were of much more slender proportions and the spaces between them were much wider than in the Egyptian structures, owing to the fact that there always existed a systematized relation between the diameter, height, and spacing of the Grecian column, and also between the mass and the mass of the superstructure, which relation varied in different designs, but was always uniform throughout the details of any single design.

**24.** In Grecian architecture we find three separate systems of design, each of which may be readily distinguished by the capital of its column. These systems are called **orders,** and are classified as the *Doric* order, the *Ionic* order, and the *Corinthian* order, being named after the section of the country where each system is supposed to have originated. Each of these orders consists of three principal divisions; first, the stylobate or substructure, on which the columns rest; second, the column itself standing on the stylobate, and supporting the third division, called the entablature, which is the superstructure consisting of the beams and architraves used in forming the roof. Of these three divisions, the column and entablature are again subdivided as described hereafter.

**25.** The **Doric order** is shown in Fig. 19, which is the front elevation of the Temple of Athena Parthenos, otherwise known as the Parthenon, a plan of which is shown in Fig. 18. The columns already referred to in the facade of the tombs at Beni Hassan, Fig. 10, and those in the southern temple at Karnak, are indisputable evidence of the source from whence the design of the Doric column was received. The Greeks took the crude article, perfected it, and made it an order of their own.

The height of the Grecian-Doric column is from four to six times the diameter, and it stands without any intermediate base, immediately on the stylobate, as shown in Fig. 19, where *a* is the stylobate under the column *b*. The column is divided into two parts, the shaft and the capital, the former being the straight portion shown at *b*, while the capital is the cushion-shaped block *c* interposed between the shaft and entablature to receive the superimposed weight and concentrate it at the top of the column. The diameter of the shaft is less at the top than at the bottom, the diminution being effected, not in a straight line from the bottom to the top, but in a curved line which renders the face of the column slightly convex or barrel-shaped. This curved profile is called the **entasis** of the column, and its purpose is to overcome the optical illusion, which causes long straight lines to appear hollow or concave. This curvature of outline was maintained throughout the entire building, and in consequence there is not a straight line in the entire structure. The lines of the cornices, pediment, steps, and side walls, all have a slight entasis, varied in amount to suit each particular case.

The entablature is divided into three parts, the architrave *d*, the frieze *e*, and the cornice *f*. The architrave consists of the short lintels, which extended from column to column all around the building, and in the Doric order are always left to form a plain band, as shown. The frieze is formed of the band between the architrave and cornice, and is broken by the **triglyphs** *g* and the **metopes** *h*, the former representing the ends of transverse beams resting on the architrave, while the metopes are carved slabs inserted between the beams to close the open spaces. The triglyphs derive their name from the grooves, or channels, *k* cut in their faces; two being cut in the middle, and half a channel cut on each side, making in all three channels, or "glyphs," which is the meaning of the term *triglyph*.

The cornice *f* consists of the finish along the edge of the slabs, or tiles, which form the roof covering. It was usually carried up above the lowest part of the roof slope, and thereby formed a gutter, which collected the rain water and retained it until discharged through numerous gargoyles, or spouts, carved in representation of lions' heads, as shown at *l*.

**26.** To the Greeks we are indebted for the invention of a new architectural form, the **pediment.** This exists at the ends of the temples, and is formed by the triangle under the roof slopes. The upper molding of the cornice was carried across the ends of the building from each side on a line with the roof slope, as at *l n* and *o n*, while the lower member was carried straight across the end of the building, as from *l* to *o*. The triangle *l o n* then forms a *pediment*, while the surface *m* which is enclosed by the moldings is called the **tympanum,** and was frequently decorated with sculptured figures as in this case, but equally often was left perfectly plain. The soffit, or under side, of the lower member of the cornice was ornamented with a number of projecting slabs representative of the ends of the rafters in the sloping roof. These slabs were called **mutules,** and are shown at *p* in Fig. 19. They were placed regularly around all four sides of the building, being centered over each triglyph and metope.

**27.** The Doric was the order especially loved by the Greeks, and as used in the Parthenon is as complete and as perfect an architectural feature as has ever been known in history. The design of the Parthenon is regarded with a feeling of reverence by the entire art world. It is the standard of perfection, the acme of simplicity, and the monumental witness of the reverence of the Greeks for their national deity, Athena Parthenos. In Fig. 20 is shown a view of the Parthenon, made from a restored model of the temple now in Columbia College Library, New York. This model shows the building as completed by the architect Ictinus in the year 438 B. C., while Fig. 21 shows the present condition of the structure as it stands today in ruins on the Acropolis at Athens.

**28.** The Greeks, like the Egyptians, used no mortar in the construction of their buildings, but carefully fitted each stone to its proper place and depended upon the force of gravity alone to render their structures stable. The columns of the Parthenon were not composed of single shafts of marble, but were built up of courses, each course being about equal in height to its diameter. These were doweled together at the center, and their bearing surfaces so nicely fitted that the joints were scarcely distinguishable, except

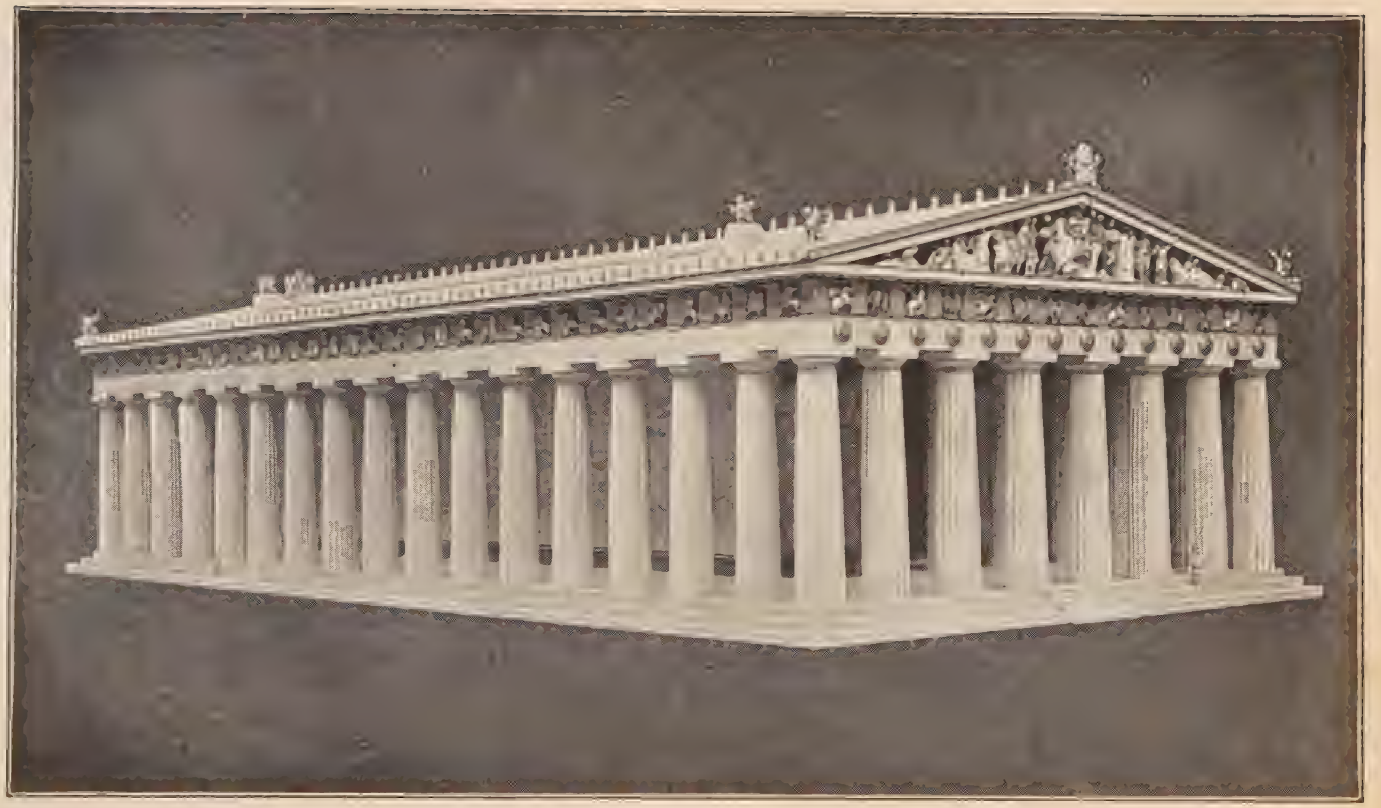


FIG. 20.

upon close examination. The stone blocks composing the walls of the naos were similarly doweled together, and also the members of the entablature and pediment. Each member was designed to receive only a vertical stress, due to its own gravity and that of its superimposed load; and depending thus only upon natural forces, the Greek structures were theoretically perfect in construction, and defied the disintegrating effects of time and the elements for hundreds of years. The Parthenon stands in ruins today, as do all other ancient Greek structures, but the ruin has been caused by the vandalism of conquering nations, and not through any faulty construction by the original Greek architects. Up to the year 1687, the Parthenon stood on the Acropolis at Athens, very nearly as perfect as when completed by its architect Ictinus in 438 B. C., having resisted the elements for 2,000 years, but it was then, during the war between the Venetians and Turks, used as a storehouse for gunpowder, and an accidental explosion wrought the ruin we find there today.

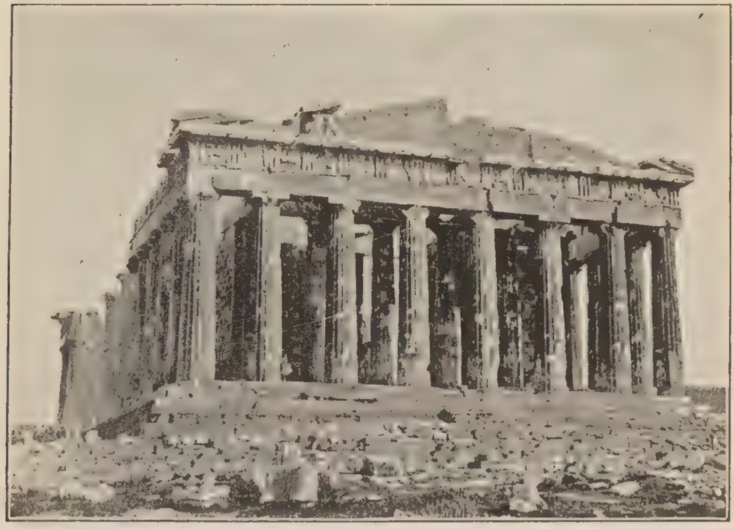


FIG. 21.

**29.** The **Ionic order** is shown in Fig. 22, which is an elevation of the north porch of the triple temple known as the Erechtheum. The column in this order is more slender than in the Doric, being about eight or nine times its diameter in height, and instead of being divided into two parts it consists of three subdivisions, the base *B*, the shaft *C*, and the capital *D*, while the stylobate *A*, on which the column stands, is practically the same as the Doric order. The base *B* is designed to spread the load transmitted by the column over a larger area than the section of the shaft represents, and is required in this order on account of the more slender proportions of the column. The shaft *C* possesses

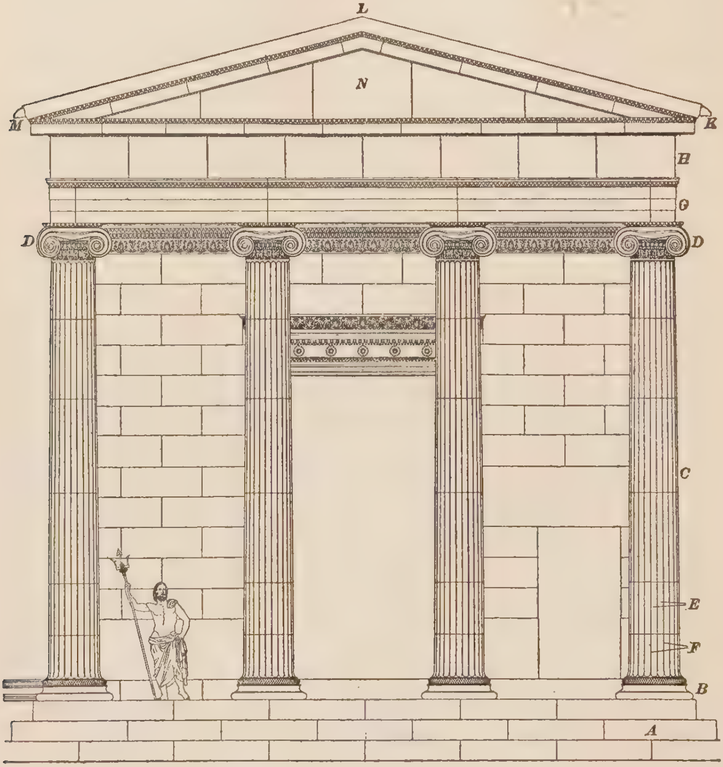


FIG. 22.

an entasis and is grooved by twenty-four flutes *E*, which do not meet in a sharp edge or arris as in the Doric order, but are separated by a narrow fillet *F*. The capital *D* is the distinguishing characteristic of the Ionic order. Its volutes, or spirals, suggest that its design may have been influenced by Assyrian ideas, as similar volutes are seen in certain capitals used by the Persians after their conquest of Assyria, as shown in Fig. 14. The architrave *G*, unlike that detail in the Doric order, is composed of three bands, each of which projects slightly beyond the one below, and the frieze *H* is in this order a plain band unbroken by triglyphs or other details as in the previous order. The cornice is somewhat similar to the Doric in its proportions, but differs materially in its details, and the tympanum *N* under the pediment *K L M* is not ornamented with sculpture in any of the Ionic temples, remains of which are now in existence.

It will be observed that while this order is devoid of sculptured figures, many of the moldings are richly carved, while in the Doric order none of the moldings were carved, but nearly all of the plain surfaces were relieved by means of sculptured designs.

**30.** The Erechtheum, from which this example of the Ionic order is taken, was, as said before, a triple temple, and is the exception referred to in Art. **22,** when reference was made to the symmetrical system of design in Grecian temples. A plan of this structure is shown in Fig. 23, which exhibits the peculiarities of its outline. It combined three temples, that of the Greek god Erechtheus at *a*, and of the goddesses Pandrosus and Athena Polias at *b* and *c*, the design being intentionally unsymmetrical, not only in plan but in elevation, as the three temples were on different levels, and were varied as widely in detail as circumstances would permit. The porch of the temple of Athena Polias on the north side was on the lowest level and contained six columns, four in front, as seen in Fig. 22, and one on each side. The temple of Erechtheus on the east side contained six columns in its porch, but they were all arranged along the front, and none were used at the sides, as shown in Figs. 23 and 24. Fig. 24 is an outline elevation of the east side of the temple of Erechtheus, showing the arrangement of the six columns of the porch.

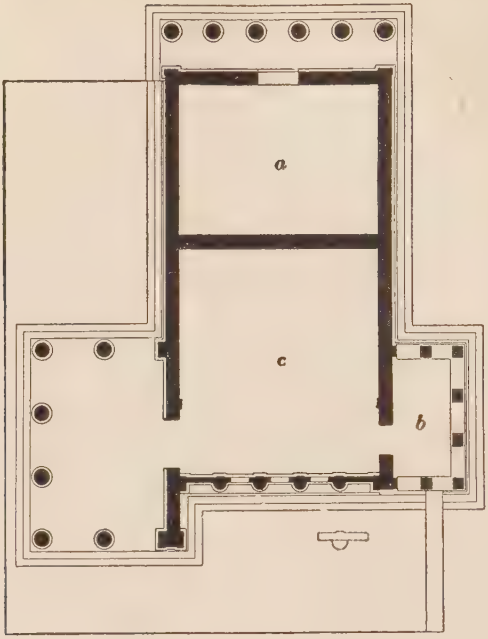


FIG. 23.

In the temple of Pandrosus, the roof is not supported on columns at all, but on the heads of sculptured female figures called *caryatids*. A front elevation of this last temple is shown in Fig. 25. As will be observed, the Grecian architect exerted every effort in his power to prevent this building from having the appearance of a single temple dedicated to but one god. In

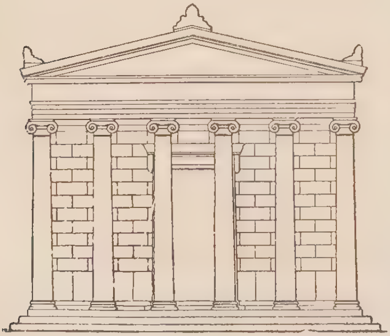


FIG. 24.

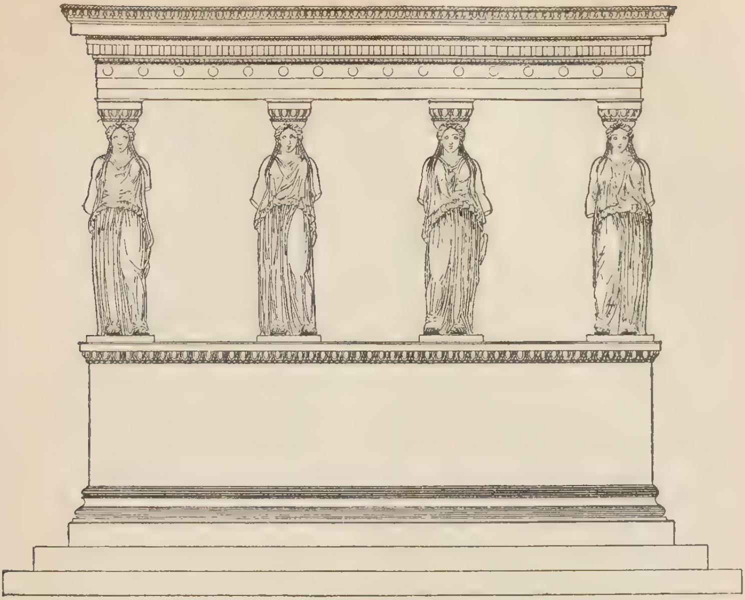


FIG. 25.

Art. **1** is explained what is meant by character in a building; surely, then, this Greek temple had character, for it shows clearly by its form and proportion that it was a triple edifice erected for the worship of three gods. Fig. 26 shows the north porch of the Erechtheum in ruins as it now exists. Many of its stones have been removed to build the walls and fortifications of the Acropolis itself, but enough still remains to impress the observer with the dignity which the complete edifice must have inspired.

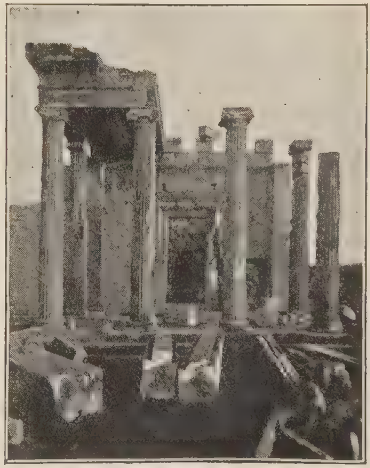


FIG. 26.

**31.** Another Ionic structure which was demolished and built into the Acropolis walls, is the little temple of Nike Apteros, or Wingless Victory. This little edifice was rescued by architectural students, however, and rebuilt in its original position, on the right of the Propylæa stairs, as shown at *d* in Fig. 29. Fig. 27 shows the front elevation of the Temple of the Wingless Victory, as it existed after the restoration. The frieze is observed to be carved with various human figures, a condition unusual in the Grecian-Ionic buildings.

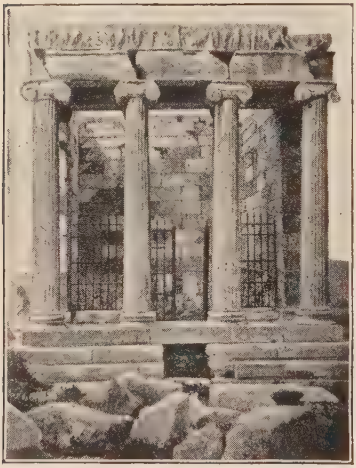


FIG. 27.

**32. The Corinthian Order.**—There is only one perfect example of the Corinthian order found in Greece at the present day, and this is the little structure known as the Choragic monument of Lysicrates, shown in Fig. 28. This stands on a square pedestal built to receive it, and is surmounted by a bronze tripod; but these details form no part of the order itself. The stylobate is, in this example, circular in plan, and the columns are arranged around and against a cylinder; but we will consider them and the superstructure as though they were entirely detached, as in the previous examples. The shaft of the column is grooved by twenty-four flutes separated by fillets, as in the Ionic order, but is longer in proportion to its diameter. It has also a molded base similar to the Ionic, but which is spread more on account of the smaller sectional area of the column. The capital is taller than that of either of the other orders, and is carved in representation of foliage arranged around a bell-shaped core. The entablature is similar to that division of the Ionic order, but is much richer in moldings and carved figures. Owing to the fact that we have but one example from which to study the details of the Grecian Corinthian order, it is impossible to state exactly what the general proportions were, as this little monument, so different in its character from the other architectural monuments of Greece, may as likely have been an exception to the general rules of proportion, as in accordance with them. It is accepted, however, at the present day as the standard of Greek-Corinthian order.

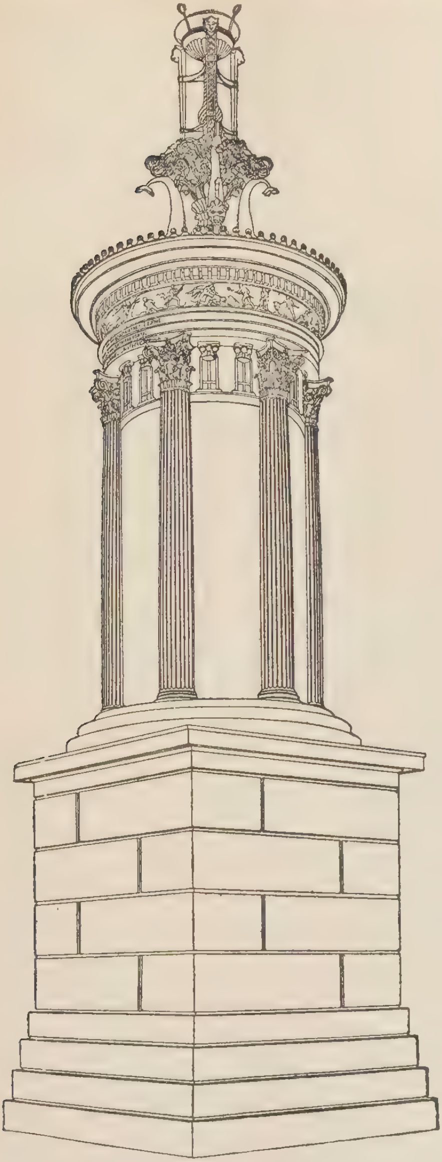


FIG. 28.

**33.** The *Acropolis* at Athens on which stood the Parthenon, Figs. 20 and 21, and the Erechtheum, Figs. 22 to 26, was a fortified hill surrounded by a wall which was pierced by nine gateways, the principal one of which was called the *Propylæa*, and is shown at *a* in Fig. 29. It consists of a Doric *hexaprostyle* portico (which signifies a six-columned prostyle), having the two center

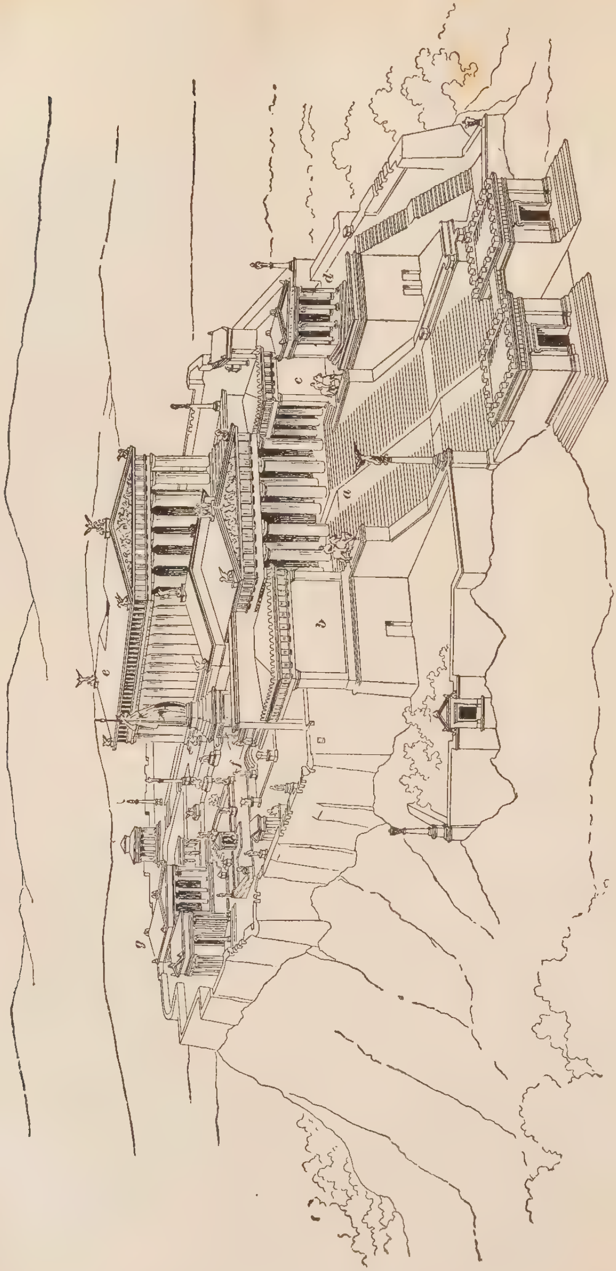


FIG. 29.

columns separated more than usual, in order to form a wider passageway for the religious processions. Beyond this is a vestibule divided into three parts by two rows of Ionic columns, each row of which forms the front of a small *tristyle*, or three-columned temple *in antis*, to the right and left of the vestibule, as shown at *b* and *c*. The whole structure, though extremely elegant and possessing many beauties, is not as good an architectural composition as the Greeks are generally capable of. The unequal spacing of the columns detracts from the harmony, and the Ionic columns in a Doric ordinance are very objectionable.

Beyond the Propylæa the summit of the hill was leveled off to form a plateau, and prominent on the south side stood the celebrated Parthenon at *e*. A monument of Athena *f*, directly in front of the center of the Propylæa, represented the goddess equipped with spear and shield in her character as defender of the nation, and to the left of this monument and northeast of the Parthenon stood the Erechtheum, as shown at *g*. Smaller temples to minor divinities, and statues of heroes and gods, were numerous along the walls of the Acropolis, and the entire plateau was laid out to make a most impressive architectural mass, worthy of the divinities to whom incense was burned on the numerous altars.

**34.** The *tombs* in Greece proper are of no great account architecturally, but in the Greek colonies there are several of great importance. The colossal Mausoleum at Halicarnassus, erected to Mausolus, King of Caria, was an immense Ionic structure, 140 feet high and 115 feet square at the base. The richness of its sculptures and the beauty of its proportions made it an object of great admiration among the Greeks, by whom it was classed as one of the seven wonders of the world.

**35.** *Greek theaters* were interesting structures, but were entirely different from the same class of building we see at the present day. They were cut out of the rock on a side hill, and arranged in the form of a semicircle, with seats in rows parallel with the circumference. The stage was built across the center, back of which the scene was set, and the whole enclosure was covered with an awning called the **velarium,** arranged to protect the spectators from the sun. The velarium was stretched from the top of a row of columns which were the only architectural feature visible from the outside of the building.

**36.** Of *private houses* no remains exist, but it may be accepted as a fact, that they were very simple in plan, while the decorations and ornaments must have been chaste and refined, as every article of Greek origin, whether coin, medallion, vase, implement of war or husbandry, was a model of delicacy and refinement which no nation has ever equaled.

**37.** To the Greeks we owe the greater part of the beautiful and delicate details of columnar architecture. To them we are indebted for the most refined methods of obviating the defects of optical illusion. The apparent depression in the cornice, across the front of the temples, caused by the mass of material and apparent weight in the center of the pediment, was obviated by curving the cornice so that the center was highest. The steps were curved in the same way; the architrave and frieze of the Parthenon sloped about 1 part in 80 towards the center; and so it was in all the minute details of construction. The Greeks not only avoided structural weakness in design, but invented methods to overcome even the slightest appearance of such weakness.

## ETRUSCAN ARCHITECTURE.

**38.** The Etruscans, a people of Asiatic origin, entered northern Italy about 1300 B.C. Their written language has never been translated, and their architectural monuments are so few that we have been able to learn but little of their habits and customs. But the influence of the Etruscans in the architecture of their southern neighbors, the Romans, is everywhere apparent. The walls of the Etruscan cities are splendid examples of the Cyclopean style, but are of much more importance historically, as they contain the first examples in Europe of the **voussoired arch.** As has already been mentioned, there are examples of the arch both in Egypt and Assyria, but it is very uncertain whether its principles were understood in those countries, while it is comparatively assured that the Etruscans understood them perfectly. The only remaining Etruscan antiquities are the tombs, which are divided into two classes, those cut out of the solid rock, and those erected above ground. Some of these latter are built over a chamber excavated out of the rock, while others are built entirely above ground. Bas-reliefs carved on the **sarcophagi,** or stone coffins, remind us of both Assyrian and Egyptian art, but the tendency toward the circular form, both in plan and elevation, marks the distinguishing characteristic of the few monuments now remaining.

## MODERN ARCHITECTURE.

### ROMAN ARCHITECTURE.

**39.** With Rome, ancient history ends, modern history begins. Heathenism declines, Christianity dawns, and though with this new faith comes a new architecture, it must be understood that Roman architecture was fully developed before Christianity arose. The Roman people were not an imaginative race, and had few original ideas in architecture. Their early works were copied from the Etruscans and their later efforts were borrowed from the Greeks.

**40.** We now enter into that period of history when buildings were erected according to the second principle of architectural design referred to in Art. **1;** namely, the **arch.** The distinguishing characteristic of all Roman architecture is the use of the arch. In other countries it was used very sparingly, never as an architectural feature, and seldom as an engineering device. The Romans, however, were as profuse in its application as their predecessors were persistent in its omission. In constructive ingenuity the Romans excelled all former efforts which the world had seen. Their buildings rivaled in scale those of Egypt, and in variety surpassed those of Greece, while they unsuccessfully tried to combine the beauties of each.

The attempt to Romanize the Greek orders cannot be considered a success. The Romans could not appreciate the simple grandeur and dignified beauty of the Doric order as it existed in Greece, and molded it on what we suppose the *Tuscan* to have been. It was used in forums or public squares, courtyards, and arcades, and for such purposes was more manageable than the pure Greek form, originally designed exclusively for sacred edifices. Before the addition of an independent base, the column was a characterless ordinance, and in this condition it may be seen in Fig. 30, which is a view of a part of the walls of the theater Marcellus at Rome. Their modification of the Ionic does not compare favorably with the original, as the Romans seemed neither to have liked nor to have understood it. In Greece the Ionic column was generally used between the antæ, or pier-like terminations of the side walls. In this position the voluted face was always parallel to the face of the architrave, and when used in temples, where it was necessary to carry the columns or pilasters along the side, as in the north porch of the Erechtheum, shown in Fig. 22, the Greeks caused an extra volute to be cut on the corner column, as shown at *D*. The Romans adopted this form, which had been designed for a special requirement, modified it to a certain extent, and used a four-voluted capital everywhere they required a detached Ionic

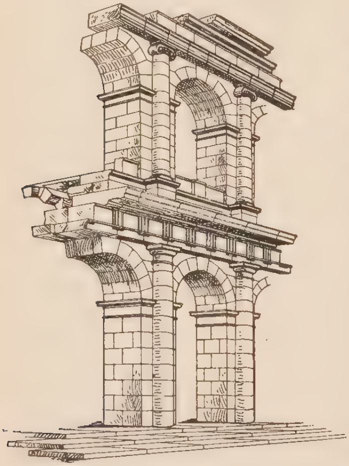


FIG. 30.

column, without apparently considering its original purpose. With the Corinthian order they were much more successful, and it became in Rome what the Doric was in Greece, the national style. Although the motive of the design was borrowed, the detail was not copied, and the Roman-Corinthian order assumed a new and beautiful character and a wonderful variation, without the loss of any of its distinctive features.

In their attempts to improve on the Corinthian, the Romans produced the *Composite order*, which was nothing more than a combination of the Ionic and Corinthian, without the addition of even one original idea. The order was not a popular one, and found favor only with the admirers of everything strictly Roman, simply because it was Roman. Roman moldings are the same as the Grecian moldings in general form, but different in contour. Roman moldings project more and are deeper cut than the Grecian, and their curves are formed with segments of circles, while the Grecian moldings always have a contour following the graceful curve of the *parabola* or *hyperbola*.

**41.** The Roman system of construction being entirely different from that of the Greeks, we find an entirely different conception of the purpose of the orders. In Greece the column and entablature were purely structural devices; the entablature consisted of the constructive details of the upper portion of the building, and was really supported on the column. In Rome the buildings were erected with heavy rectangular masonry piers, between which arches were turned to support the superstructure, and the column and entablature were applied as ornamental features to relieve the monotony of the continuous arcade. The column was placed against the center of the supporting pier, and the entablature was carried around the building above the crowns of the arches like a continuous belt course, as shown in Fig. 30. It is plain to be seen that the column and entablature form no structural part of the edifice, as the building would stand and serve its purpose equally well without them. Where a portico was carried beyond the front of a building, the roof was usually supported upon a row of columns; but even in this the Romans differed widely from the Greeks, as in these porches they nearly always made use of the Corinthian order, while the only Grecian example we have of that order is the monument of Lysicrates, which has its columns attached. In *Advanced Architectural Drawing*, the Greek and Roman orders and their characteristic moldings are fully analyzed, and the relative values of their various members explained.

**42.** Roman temples, though modeled on the plan of the Grecian, never attained the same artistic effect. The changes in elevation, and the omission of columns when the arch replaced the lintel, impaired the simplicity of the design. The Romans built both circular and rectangular temples, and with great variety of treatment. In the rectangular temples a high **podium** or basement replaced the stylobate of the Grecian edifice, and the peripteral plan was less frequent than the prostyle. The temple of Fortuna Virilis, at Rome, and the Maison Carrée, in France, are examples of this style of Roman design, the latter being well preserved at the present day, as shown in Fig. 31, though built in the first century of the Christian era.

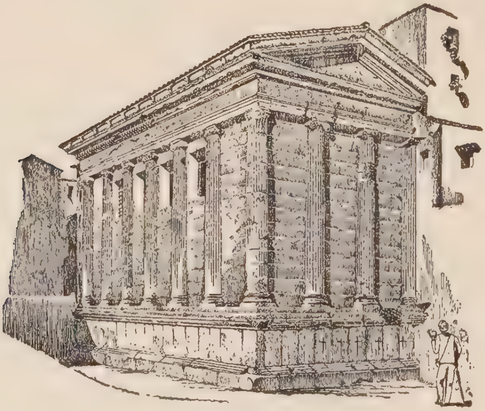


FIG. 31.

As an example of the circular temples, the Pantheon at Rome, Fig. 32, is not only the finest example, but is also one of the most magnificent religious edifices of the ancient world.

It was built by Hadrian, in the second century, its circular plan measuring 142 feet in diameter internally. The walls are 20 feet thick, and support a hemispherical dome, the crown of which rises 140 feet above the floor. Light is admitted to the interior through a circular opening, at the crown of the dome, 28 feet in diameter, being the simplest as well as the most impressive method of illumination conceivable. The dome is coffered on the interior, the moldings of the coffers, or deep panels, being so cut as to appear in correct outline when observed from below, as may be seen in Fig. 32, which shows a portion of the interior of the Pantheon. The dome, however, is not constructed of voussoired-arch stones, as are most of the Roman arches, but it is produced by corbeling, in the same manner as was the dome of the Treasury of Atreus, shown in Fig. 16. The side walls were deeply recessed and niched, to receive statues and altars, before which incense was burned to the gods. The

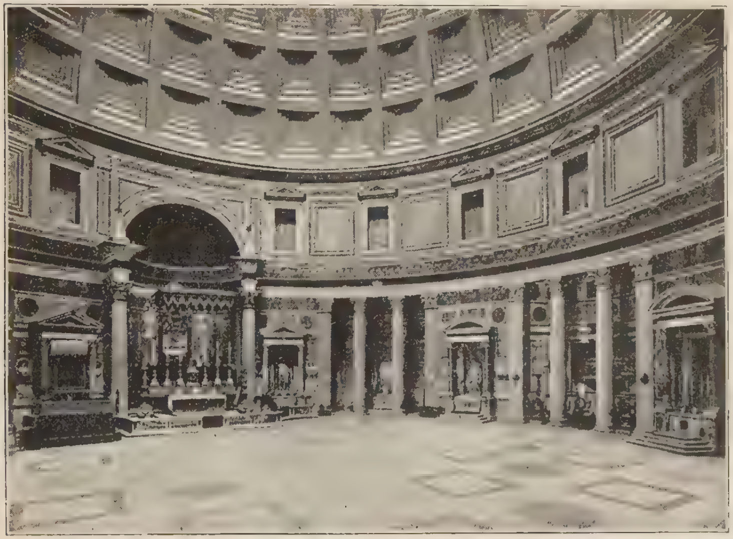


FIG. 32.

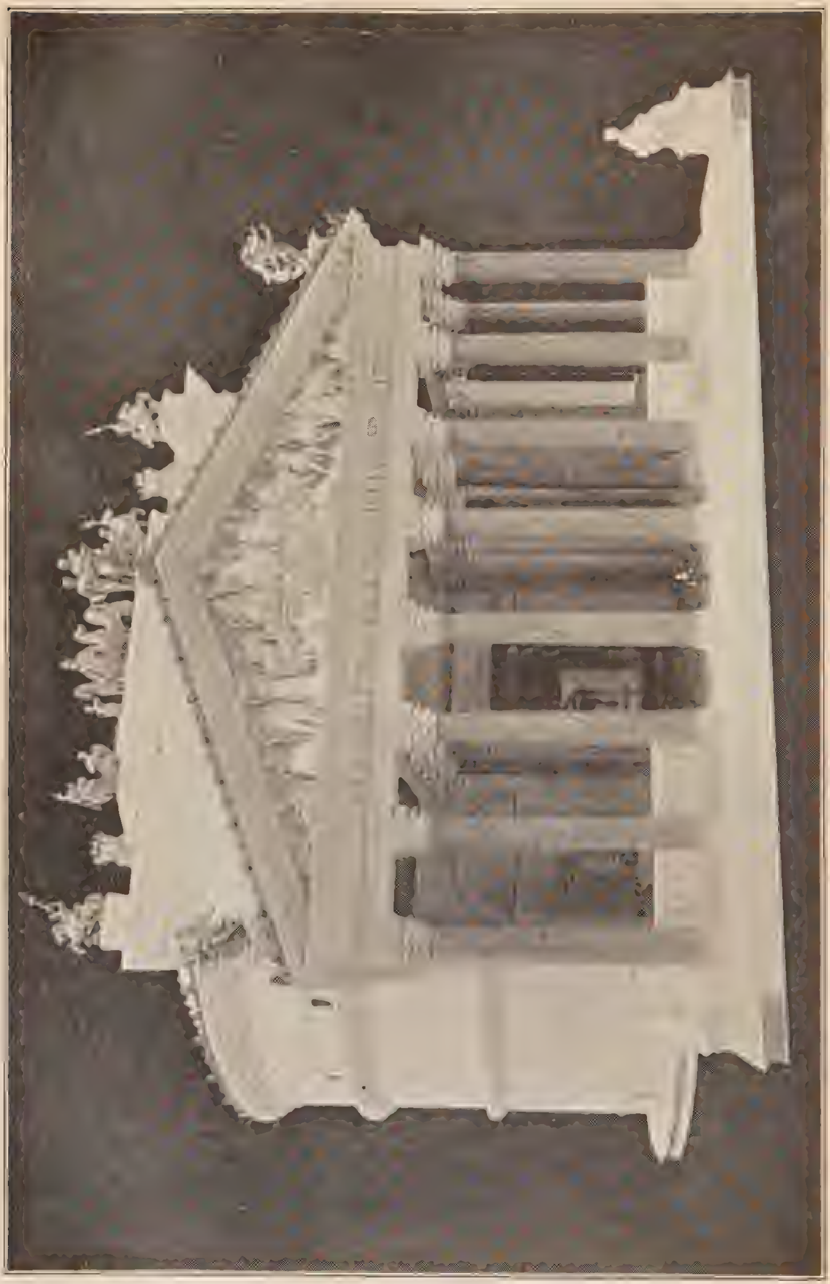


FIG. 33.

building is now used as a Christian church, however, and the niches and recesses contain emblems of the Christian faith, as seen in Fig. 32.

The exterior of the Pantheon, Fig. 33, which is reproduced from a restored model, was less impressive than the interior. The porch, with its twelve superb columns of Egyptian granite 50 feet in height, and its magnificent pediment and statues, was grand indeed, but it was ill-fitted to the circular building beyond. The capitals of the columns, minutely wrought in Pentelic marble, rank among the finest examples of the Roman-Corinthian order. The entrance to the temple is approached through three aisles, after the Etruscan style, but is effected through a single opening protected by two ponderous bronze doors. Taken as a whole, the Pantheon is certainly a masterpiece of the world's architecture.

**43.** The *Roman theaters* were similar to those in Greece, but were built on the top of a sloping side hill, instead of being hewn out of it. The decorations were more elaborate, as is true of every other building which the Romans designed after Grecian examples, but the *amphitheaters* were essentially a Roman institution, and were strictly Roman in design. These consisted of circular or elliptical structures,

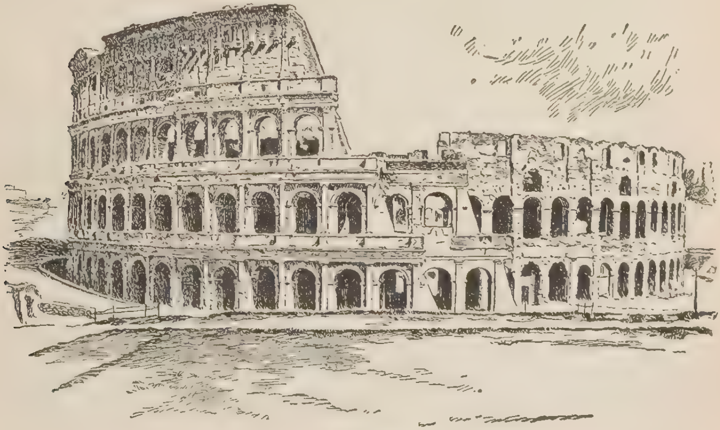


FIG. 34.

with seats in parallel rows all around, while in the center was the stage, or arena, where the performance took place. These performances were generally of the character of fights, either between armed men, called gladiators, or between a man and a wild beast, such as a lion or a tiger. They were very bloody contests, and tend to show the character of a people who could enjoy them. The largest amphitheater was the celebrated Colosseum, shown in Fig. 34, founded by Vespasian, 75 A. D.; it was 622 feet by 528 feet, elliptic in plan, and seated 87,000 persons, while, including the standing room, it would accommodate over 100,000.

**44.** Roman *tombs* varied greatly in form, some being circular, like their Etruscan prototypes, as was that of Cæcilia Matella, Fig 35, while others were rectangular, like the Greek plan. They contained sarcophagi for the bodies, or niches and urns for the ashes of the dead, the Romans practising both cremation and burial. The round tombs formed

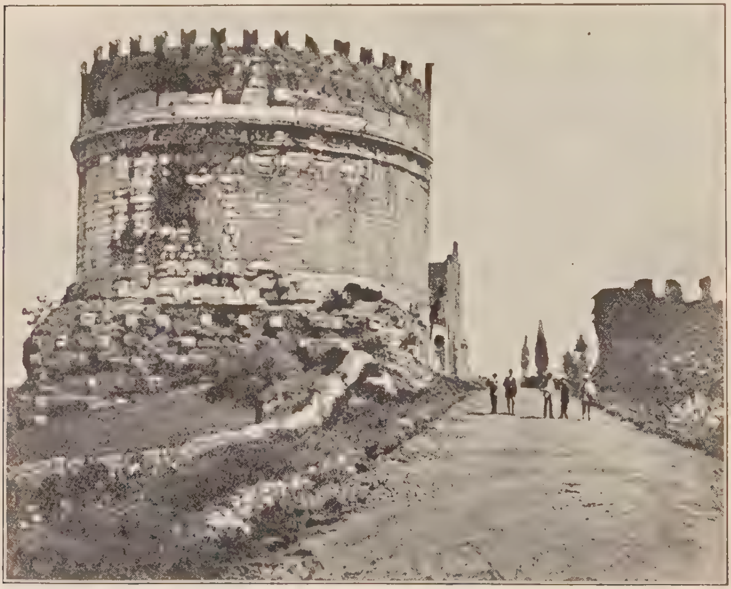


FIG. 35.

the prototype of a special form of Christian edifice of which we shall presently learn.

**45.** *Triumphal Arches* and *Columns of Victory* were objects of special attention in Rome, where the citizens cared more for these symbols of their successes than for monumental temples dedicated to their gods. The triumphal arches were built across the principal streets and roadways, and were richly carved and inscribed with the date and description of the event which they commemorated. In Fig. 36 is shown the arch of Constantine, erected 312 A. D. in commemoration of Constantine's victory over Maxentius. This structure consists of an immense block of solid masonry pierced by three arched openings, each side of which a Corinthian column supports a richly molded entablature under an attic, or superstructure, which extends full width of the monument. Elaborate carvings and sculptures, both of detached figures and bas-reliefs, are executed on all sides, while over the center arch the dedication in Latin explains the occasion of the monument's erection.

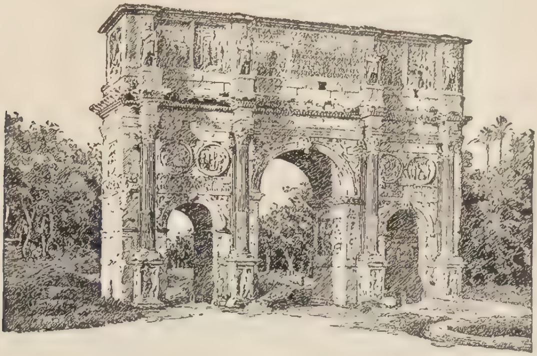


FIG. 36.

**46.** The Roman *basilicas* are of great importance to us in later history, as they became the first houses for Christian worship, and from them the plans of our later cathedrals were developed. Originally built as a court of law, the basilica in plan was a rectangular hall twice as long as broad.

On each side was a row of columns which returned across the ends, forming a vestibule in front and an elevated tribunal court at the back. Above the aisles formed by these columns was a gallery, with another set of columns supporting the roof, and the staircase leading to the outside of the building. Back of the tribunal court was a semicircular *apse*, or recession, forming an alcove, where the prætor's, or chief judge's, seat was placed. These basilicas were covered with wooden roofs, and nearly all of them have been wholly or partially destroyed by fire.

In Fig. 37 is shown a longitudinal section of the Basilica Maxentius, or Temple of Peace, in Rome, originally started by Maxentius as a pagan temple, but completed and converted into a Christian basilica during the reign of Constantine, about 313 A. D. This was the first vaulted and fireproof basilica erected, in consequence of which it has withstood the ravages of time, down to the present day, to a sufficient extent for us to determine the details of its original design.

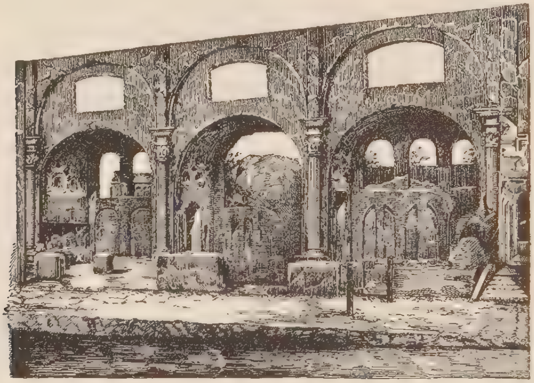


FIG. 37.

The Romans used the vault conspicuously in all of their structures, but they did not construct it as scientifically as they did the arches in their walls. When a room or passage was covered under a fireproof roof, a semicircular or wagon vault was thrown across from one side to the other, with its abutments resting upon the side walls of the room. This vault was usually constructed of concrete laid over wooden centers or templets, which remained in place until the concrete set and hardened, and were then removed. Brick or stone arches constructed with voussoirs were sometimes built at regular intervals to support the centers, and in these cases the brick arches were permitted to remain, and form a part of the permanent vault, after the centers were removed. As the slightest displacement of the side walls would render the concrete crust of the vault likely to crack, it was necessary to make these walls very massive, so as to withstand the horizontal thrust.

**47.** In concluding this account of the classic and earlier styles of architecture, we take particular note of the legacy of certain architectural forms transmitted from generation to generation, some of which became perfected, as in Greece, while others, equally beautiful, may have been lost entirely in the ravages of war and strife that pervaded these thousands of years. The fact that every new religious faith was always followed by a change in architectural style, shows how closely allied are the studies of these two subjects. We observe also how, through all this history of heathendom, that the Egyptians and the Greeks, though pagans and idolaters, were a devout and conscientious people, and erected for their gods the most magnificent temples the world has ever seen. The Parthenon, Propylæa, and Erechtheum are monuments inspired by the most profound religious sentiment.

In strongest contrast to this, are the architectural monuments of the Romans. Colossal as the temples of Egypt, magnificent as the palaces of Assyria, their structures express no higher feeling than an abnormal desire for ostentatious display. Living in luxury, upon the plunder of successful wars, the Romans gave more thought to the erection of monuments that would remind them of their successes, or appease their appetites for enjoyment, than to the dedication of temples that would inspire them with religious fervor.

Of the former class are their triumphal arches and pillars of victory, while the famous Colosseum, with its bloody history of gladiatorial contests, is an example of the amusement they craved.

Their desire for splendor, however, led them to the most wonderful engineering feats of the times, and after they discovered the principles of the voussoired arch, there was hardly a limit to their engineering enterprise. Aqueducts, bridges, sewers, and vaulted cellars were constructed everywhere, and in their architecture they arched every opening that appeared. They copied the Greek temples in plan, but removed columns wherever they saw fit, and boldly threw an arch across the intervening space. So we can safely assert that the most striking characteristics of Roman architecture are the persistent use of the arch and the tendency to extremely elaborate decoration.

The Romans adopted the Greek orders, but elaborated them. They seldom used detached columns on the exterior of a building except for porticos, as may be seen on the Pantheon, Fig. 33. Their buildings were essentially constructed of solid masonry walls, pierced with arched openings, between which columns were planted against the piers, purely for decorative effect. This treatment may be seen in the Colosseum, Fig. 34, and the arch of Constantine, Fig. 36. The Romans were the first to superimpose the different architectural orders in stories, as in the theater Marcellus and Colosseum; and the podium, or pedestal, with which they supplanted the Greek stylobate, they used independently under single columns when occasion required, as in the arch of Constantine.

## EARLY CHRISTIAN ARCHITECTURE.

### TRANSITIONAL STYLES.

**48.** For the first traces of Christian architecture, we must turn to the *catacombs* in and around Rome. These were underground galleries hewn out of the soft rock, where the persecuted Christians were compelled to retire to hold their services of worship and to bury their dead.

This labyrinth of excavated passages dates back to the first century of the present era, and for over three hundred years it was the only place where those who professed Christianity could assemble without fear of attack by the Roman soldiers. In the year 313 A. D., Constantine I, emperor of Rome, became converted to the Christian faith and issued the famous "Edict of Milan," which extended to the Christians civil and religious rights and privileges equal to those enjoyed by the pagans throughout the empire. Thus freed from tyrannical constraint, the Christians immediately sought some suitable buildings in which to set up their church. The existing tombs and temples were too small to adapt to a form of worship where there was likely to be a large assemblage of people, and though several of the larger ones were converted into Christian churches, they were afterwards abandoned for more commodious quarters.

**49.** The Roman *basilica* was finally selected as the best existing structure in which to hold the services of the Christian church, and so suitable did it prove to be that down to the present day few alterations have been made in its plan. The semicircular apse, raised and railed off from the main part of the building, was a most suitable place for an altar, while the wide, open aisles provided ample space for the assemblage of the congregation.

When structures were later erected purposely for the use of the church, the same plan was adhered to and the buildings were still called basilicas; but instead of keeping the aisles all parallel with the length of the building, a cross-aisle, called the **transept,** was introduced near one end, and the sides of the building were extended somewhat at the extremities of this aisle, thus converting the rectangular plan to the form of a cross. The center aisle from the transept to the entrance then became known as the **nave** of the church, and the part from the transept to the apse was called the **choir.** The nave was usually built to extend above the roofs over the side aisles in order to form a clerestory for the admission of light, and windows were introduced in the side walls for the same purpose; but the walls at the ends of the church, and particularly those of the apse, were left solid in the early basilicas, and decorated with paintings and symbolic designs in mosaic.

The first three edifices erected solely for the purpose of Christian worship, were the basilicas of St. Peter, St. John Lateran, and St. Paul. The first named was by far the finest, being 380 feet long and 212 feet wide. All three possessed five aisles (though later basilicas were limited to three), and the central aisle, or nave, of St. Peter's measured 80 feet across.

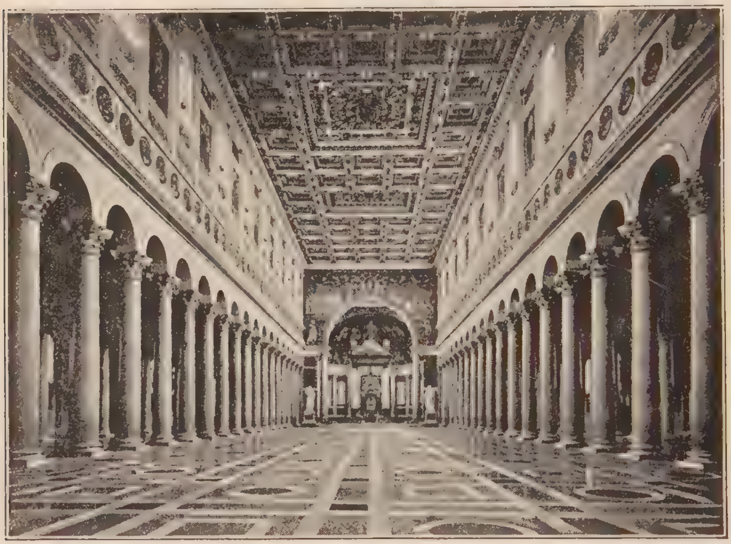


FIG. 38.

The structures each fronted on a large open courtyard called the **atrium,** where converts to the faith, and candidates for baptism, assembled during certain services held in the church, to which they were not admitted. The atrium was considered a most important adjunct to the early basilicas, but was abandoned when, after the fall of the Roman Empire, the church became an independent power and structures were erected in remote districts, away from the influence of their early Roman prototypes.

Of the above three edifices, St. Peter's was demolished and rebuilt in the fifteenth century, St. John's was extensively altered, and St. Paul's was destroyed by fire in 1821. This church has been rebuilt, however, and stands today almost in its pristine splendor. Fig. 38 shows the interior of the church as restored, while in Fig. 39 is shown the cloisters with their eccentrically carved columns and capitals.

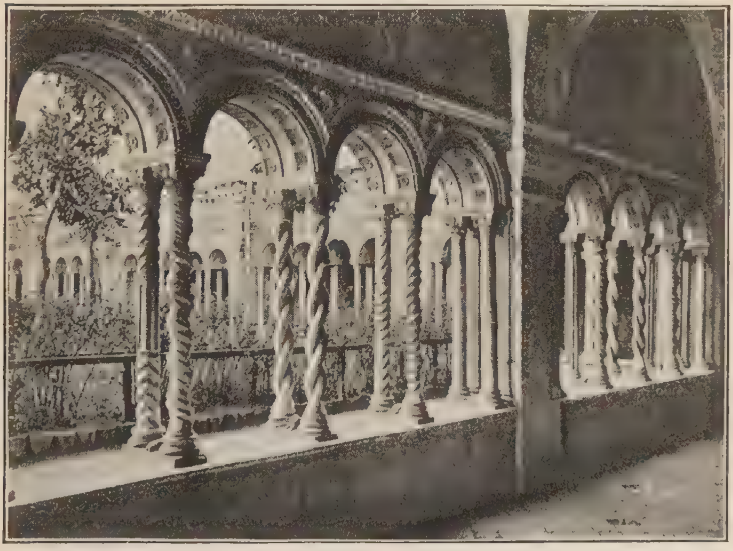


FIG. 39.

**50.** With the fall of the Western Roman Empire in A. D. 476, the Christian religion became diffused among two great races of people. All in the eastern part of Europe were of Slavonic origin, while those in the west were of Celtic or Teutonic races, and a line drawn from Memel, on the Baltic Sea, south to Spalatro, on the Adriatic Sea, would practically divide these two peoples, and cut Europe in nearly equal portions.

The change in style which marked the architecture to the east of this line was known as *Byzantine*, from the city of Byzantium (now Constantinople), where it was developed, while in the west, the style was called *Gothic*, from the race of people called Goths, who overthrew the Western Empire. Previous to this change, however, there existed a transitional style in both the east and west, which was simply an attempt to adapt the classical forms to Christian purposes. This transitional style was known as **Romanesque,** and in eastern Europe it was perfected in the reign of Justinian (A. D. 527 to 564), when it became entitled to the name Byzantine; but throughout western Europe the Romanesque or transitional style existed until the seventh century.

Byzantium was to the Eastern what Rome was to the Western Empire, and the Byzantine style, by emphasizing every detail that distinguished Christianity from paganism, became an original school of art.

**51.** The *tombs* of the Romans formed the prototype of an important class of ecclesiastical structures called *Baptistries.* These were circular churches, usually erected in the vicinity of cathedrals, where sacramental services were held, such as burial, baptism, or marriage. They are of particular interest as showing the transitional stages between the pagan tombs and temples, with their ornament and decoration entirely on the outside, and the Christian edifices, with their colonnade and decoration entirely within the walls. It will be remembered in connection with the Grecian and Roman temples, that they were surrounded by columns, and possessed a rich entablature which in many cases was not only elaborately sculptured, but was also brilliantly colored. We arrive now, however, at an epoch where the direct reverse is the order of design. Christian churches up to the eighth century were plain and unpretentious on the exterior, but whether modeled on the plan of the basilica, as in the west, or on the style of the pagan tomb and temple, as in the east, the interior was decorated with carvings, frescoes, and mosaics to an extent never before attempted.

**52.** Early Romanesque architects never covered their rectangular structures with the Roman barrel vault, but frequently constructed domes over their circular buildings. This domical vaulting, however, was only used as an internal ceiling, which they covered with a false wooden roof.

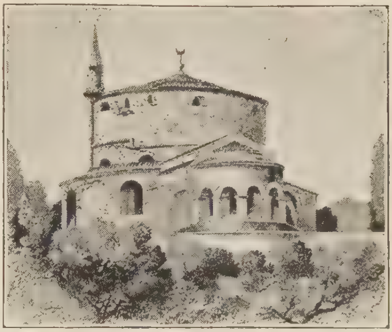


FIG. 40.

The Church of St. George at Thessalonica, of which Fig. 40 is an exterior view, and Fig. 41 a plan, is a fine example of this class of buildings. It is a circular structure 79 feet in diameter, whose walls, 20 feet in thickness, are indented by seven niches, two of which serve as entrances. The dome is hemispherical and pierced with semicircular windows, but is covered and concealed externally by a wooden roof. This interesting structure was erected about the year 400 A. D., and shows clearly the advancement and progress of Christian architecture towards the adoption of the exterior dome, which later marked the distinguishing characteristic of the **Byzantine style.**

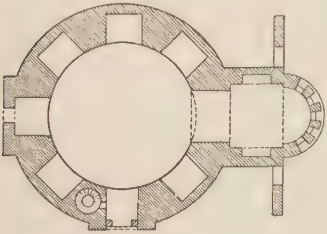


FIG. 41.

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### BYZANTINE ARCHITECTURE.

**53.** The principal characteristic of Byzantine architecture lies in its development and application of the principle of the dome. Domical structures are as prominent in the Byzantine style as arched openings are in the Roman, or trabeated openings in the Grecian designs. The Romanesque architects domed their circular and rectangular buildings to secure an impressive interior effect, but the Byzantine builders used this hemispherical detail to give character to the exterior, as well as to the interior of their edifices. The Byzantine dome was a progressive step from the Roman vault, but it was constructed on more scientific principles than its pagan predecessor, as the people that developed it were inspired by higher and more sincere motives than the constructors of temples to pagan gods, or the builders of theaters for Roman entertainments.

The system of plan had to be altered when the dome superseded the vault, but the alteration was such as was required by the construction, and not a change suggested by the purpose of the building.

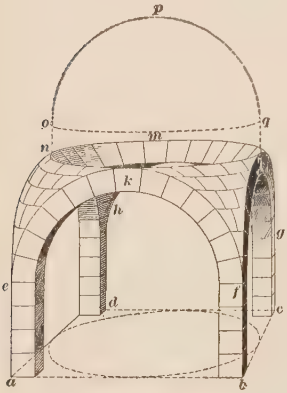

FIG. 42.

**54.** In Fig. 42 is shown a diagram of the Byzantine system of construction, *abcd* being the rectangular plan which is covered by a circular dome. Four heavy masonry piers, *ae*, *bf*, *cg*, and *dh*, are constructed at the four angles of the plan, the spaces between them being spanned by four arches, as *ekf*, *flg*, etc. Thus far the construction does not differ widely from that practised by the Roman architects; but in order to dome the enclosed area the angles were also arched over until, at the crowns of the first arches, the plan became circular, as at *klmn*. The spherical triangles thus formed at *enk*, *fkl*, etc. are called **pendentives,** and are as characteristic of the Byzantine style as is the dome itself. Over this circular opening *klmn*, the dome *opq* was constructed, resting directly on the pendentives in the earliest structures, but raised on a cylindrical superstructure, as *no*, in the more advanced buildings. The cylinder was pierced by numerous windows, to light the interior, and the weakness in construction, due to these perforations, was compensated by the construction of buttresses (against the piers between the windows), to take up the thrust of the dome.

**55.** Byzantine churches, as a rule, were nearer square than oblong, and in consequence of the system of construction, square piers connected by arches supported the roof over the center of the building instead of rows of columns connected by arches, as in the Roman basilica. This roof was always a dome, and joined to it were barrel vaults or semidomes of less magnitude. Small columns were introduced for supporting galleries and for railing off the central portion of the building from the surrounding parts. The *apse*, or the semicircular termination to the choir, was richly decorated and was invariably the principal feature of the church.

**56.** The best example of the Byzantine style is the great Church of Hagia Sophia, at Constantinople. This edifice was begun by Justinian in 532 A. D., and he announced his intention that it should be "the grandest monument ever erected by man." The governors of even the most distant provinces of the empire were ordered to ransack all the ancient buildings for sculptures, precious marbles, and works of art. Eight columns of white marble were brought from Palmyra, eight more of green marble were stripped from the Temple of Diana, at Ephesus, and shiploads of costly relics were brought from all parts of the empire to form a part of this great edifice. Ten thousand men toiled night and day for six years, and the royal treasury and private purse of the emperor were exhausted by the prodigious expense, but the church was completed, and if not up to the ideal of the emperor, it certainly was one of the grandest architectural achievements the world has ever seen. Its plan is very simple, though complicated in appearance, as shown in Fig. 43. It consists of a rectangle 229 ft. × 243 ft., in the center of which four piers, each 25 feet square, carry the semicircular arches and pendentives on which the great dome rests. Right and left of the central square, four columns support semicircular arches under the women's gallery, and on the other two sides the semicircles are vaulted with half domes, as shown in Fig. 44. Each half dome is penetrated by three supplementary vaults, as shown, the middle ones being tunnel or Roman vaults, which terminate in the apse on the east end of the church and in the entrance on the west. All the masses were disposed with studied reference to the resistance required by the many and complex thrusts exerted by the dome and other vaults, and the fact that the earthquakes of thirteen hundred years have not demoralized the structure, is the best evidence of the sufficiency of these precautions.

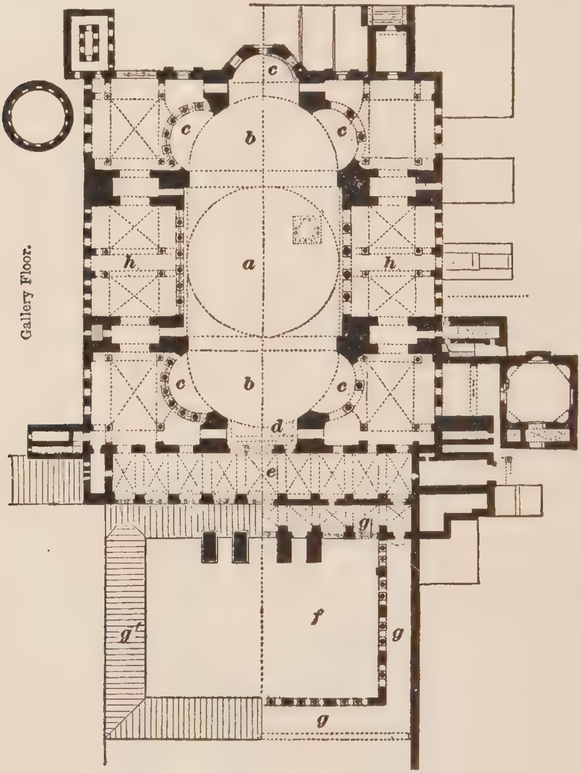

FIG. 43.

In Fig. 43, *f* represents the atrium, or open court, surrounded by a colonnade *g*, *g*, which communicates with the main building through the immense *narthex*, or vestibule, *c*; *d* is an archway connecting the vestibule with the nave *b a b*;

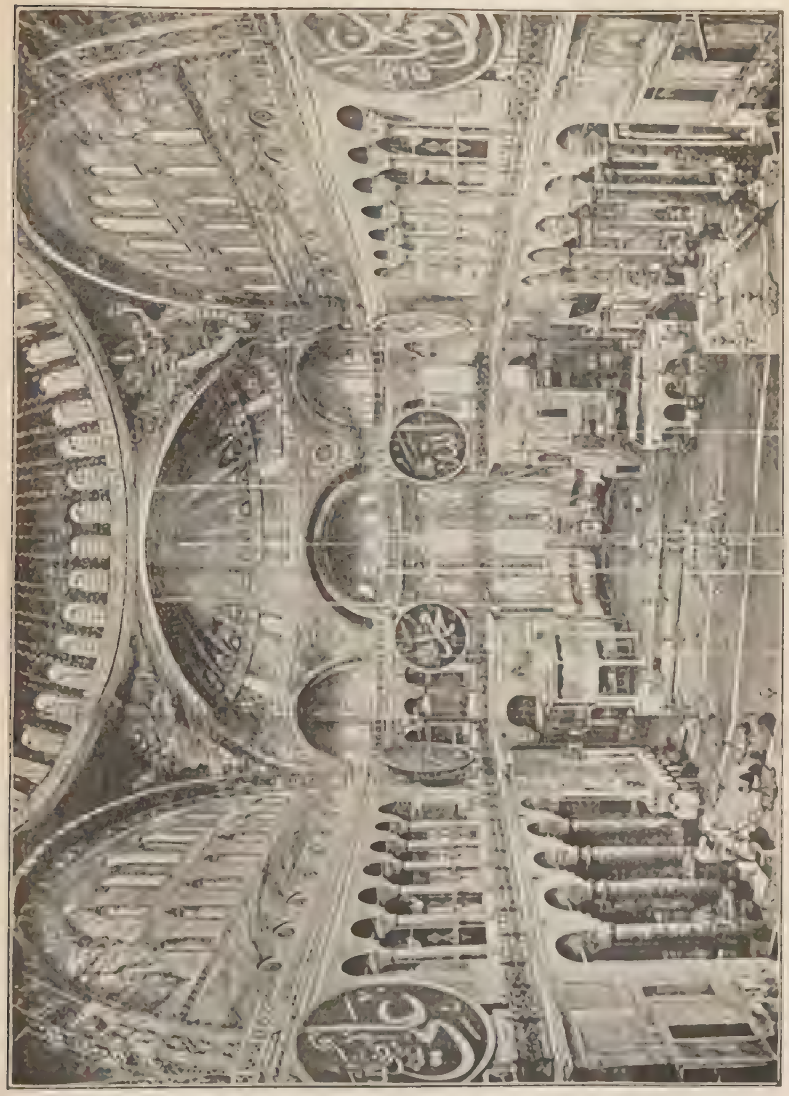

FIG. 44.

*h*, *h* are the side aisles; *c*, *c* are curved colonnaded recessions from the semicircular ends of the nave, which, as shown in Fig. 44, are surmounted by semidomes which pierce the large semidomes; *b*, *b*, in Fig. 43, shows the plan of these large semidomes, and *a* the plan of the central dome which crowns the structure. Thus was secured a noble and unobstructed hall of unrivaled proportions and remarkable beauty, roofed over by a combination of half domes, which increased in size as they led successively up to the stupendous central vault which crowned the whole. The imposing effect of this loftily poised dome, so disposed that its summit is visible from any part of the nave, is not surpassed by any interior ever designed.

Simple as is the means of securing this remarkable result, the actual effect is one of great intricacy of mass and of unceasing gradation of parts. From the small arcades and semidomes that surround the aisles, galleries, and apse, to the stupendous vault that hangs with little apparent support, like a gigantic bubble over the nave, there is a continuous change of form where one part grades or blends into another, that impresses the beholder with a feeling of unbroken repose. The right-hand portion of Fig. 43 shows the arrangement of the plan at the floor level, while that on the left side shows the arrangement at the gallery level, and also the roof over the colonnade of the narthex, as at *g'*.

**57.** The noble planning and construction of this great edifice is no more remarkable than the treatment and scale of its interior decoration and design. It is to Byzantine architecture what the Parthenon was to the Greek. With little external beauty, except the beauty of perfect construction, it is internally one of the most perfectly composed and beautifully decorated halls of worship ever erected. Contrasted with the simplicity of the Parthenon, it displays the complexity of an organism of admirably related parts. Dimmed by the lapse of centuries, and disfigured by the vandalism of the Moslems, into whose hands it has fallen, the interior of Hagia Sophia, by the harmony of its coloring and the grandeur of its parts, is one of the masterpieces of all time.

Externally the church possesses little attraction, and the numerous additions at the hands of the Mohammedans have detracted from the purity of the original design. As a system of domical construction, and a type of its style, it still exists, however, in much of its original purity, Fig. 45.

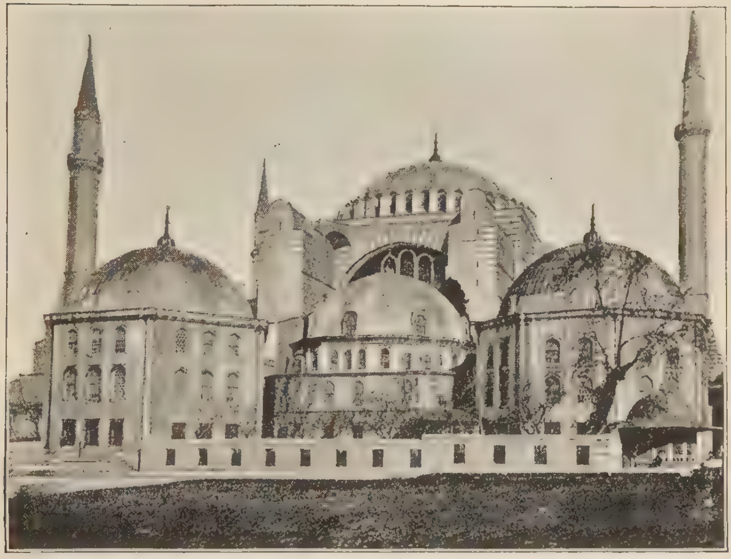

FIG. 45.

**58.** How widely Byzantine influence spread, even into western Europe, is proved by the existence of such buildings as the Church of St. Mark, at Venice, in Italy, Fig. 46, and the Byzantine Church of St. Front, at Perigueux in France. Purely Byzantine Churches do not exhibit as much exterior ornamentation as is seen on the Church of St. Mark, as this edifice was erected four centuries after Hagia Sophia, and was consequently contaminated by local influence. But, though subjected to numerous alterations during the Gothic period, St. Mark's exists today in much of its original structural grandeur of a purely Byzantine type.

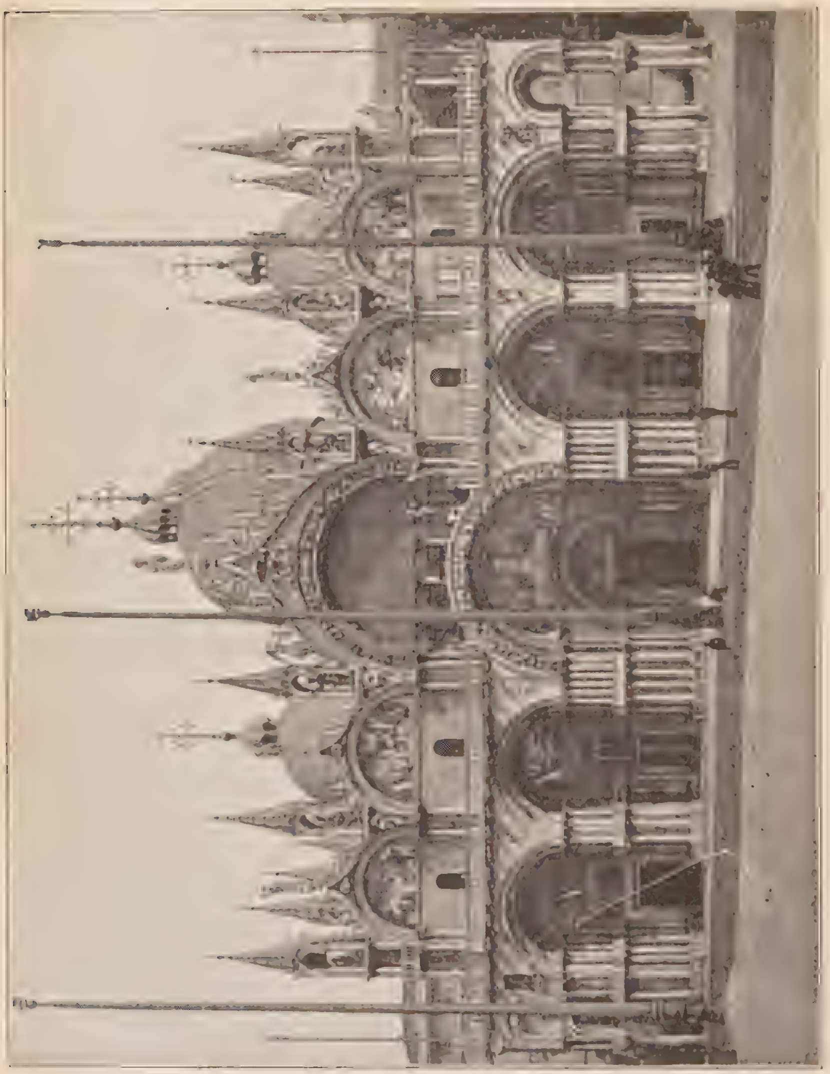

FIG. 46.

The Church of St. Front, at Perigueux, however, though copied after St. Mark's, was structurally inferior to its prototype. The form and outline of the Byzantine style were imitated, but the district was so remote from the home of Byzantine art, that the system of construction was but imperfectly understood.

## MEDIEVAL ARCHITECTURE.

### INTRODUCTION.

**59.** The fall of the Western Roman Empire in 476 A.D., marked the beginning of a new architectural era throughout all Europe, except in the Byzantine Empire. The so called "Dark Ages," which followed this event, may be considered as the formative period of western civilization, during which the barbaric conquerors of Rome were gradually Christianized, and subjected to the authority and educational influences of the church.

Under these conditions a new architectural style was developed, founded upon the traditions of the earlier Christian builders, but modified in different regions by local influences. The prevailing characteristics of the style were at first essentially Roman, for Rome soon recovered her antique prestige as the leading European city, and Roman monuments, covering the soil of southern Europe, were a constant object lesson to the builders of that time. To this new architecture of the West, which, in the tenth and eleventh centuries, first began to achieve monumental results, the general name of **Romanesque** has been commonly given, though it differed widely under the local influences of different countries.

Romanesque architecture was distinctively ecclesiastical. Civilization and culture emanated from the church, and the requirements and discipline of the religious orders gave form to the builder's art. The basilican style of building, which had so well served the purposes of the church, in the earlier centuries and on classic soil, did not suit the new conditions, except so far as its plan was concerned. Corinthian columns, marble incrustations, and splendid mosaics were not to be obtained in the forest lands of France and Germany, and the priests and monks sought to erect with unskilled labor churches of stone in which the general arrangement of the basilica plan should be maintained, but with simpler adjuncts, and as far as possible in a fireproof construction with vaults of stone. The struggle with this problem underlies the entire system of Romanesque design, while the solution of the problem characterizes the development of the Gothic style.

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## THE ROMANESQUE STYLE.

**60.** The aim of all good architects, from earliest antiquity, has been to build permanently and to build nobly—to construct a building of materials sufficiently refractory to withstand the ravages of fire and age, and to put those materials together with sufficient strength both to defy the savage onslaught of the invader, and to resist the slower but surer disintegration of time and the elements.

The great difficulty in all the medieval churches was the question of roof. Side walls and partitions could be built of stone, but the roof must be of some other material, or require the invention of a new device to hold stone in place. Now, it is the invention of just these devices, so numerous in Romanesque and early Gothic architecture, that makes medieval construction of such vast interest and importance to the architectural student. The medieval builder plodded along in his work until he struck an obstacle, then he quietly overcame that obstacle, and proceeded without boast or brag of his achievement.

The churchman of the eleventh century was simple, unassuming, and industrious. He thought little of his personal needs, but devoted his whole life to his church and faith. His patience and perseverance require no nobler monuments than the great Gothic cathedrals of the succeeding centuries, which never would have been completed had the medievalist not tried again and again to accomplish results that he had repeatedly failed to attain.

The Romans, when they wished to erect grand monuments of public utility, could not only send to the spot, no matter how remote, an army of soldiers, but by their tyrannical system of government they could compel the very inhabitants of the locality to desist from all other employments and work for the emperor of Rome. They thus achieved by a multitude of hands those prodigious results which today stand monuments not only to their enterprise, but also to their despotism.

Had the builders of the middle ages desired to pursue this course, where would they have found the army of workmen? In a country without stone, without money to buy it, without beasts of burden to transport the material if they could buy it, without even roads over which to travel, how could these people even attempt to follow the course of their Roman neighbors? The provinces were almost continuously at war with one another; each abbot and each lord was, in his own opinion, absolute sovereign over his entire domain (and often a part of his neighbor's, hence the frequent wars), and any attempt to erect a monumental structure would have been regarded with the most suspicious jealousy by the lord of each neighboring fief, the jealousy increasing in proportion to the smallness of the country over which each held power.

For the following reasons, then, the religious orders were the first who could by themselves undertake important building.

*First*, because they alone could gather together at one place a number of men sufficiently united by a single paramount thought, subject to discipline, freed from military service, and possessors, in the name of the church, of the land on which they lived.

*Second*, because the religious orders amassed property and improved it under a regular administration; because they joined in amicable intercourse with neighboring establishments; because they plowed the uncultivated lands, laid out roads, and with the fruits and tolls of their industries bought quarries and woodlands, built workshops, and offered to the peasants guarantees which were relatively certain. Thus the church lands were rapidly populated and improved, while those of the laity and nobility were continuously devastated by war.

*Third*, because the religious orders were able, thanks to the comparative stability of their organization, to form, with their monasteries, schools of artisans, subject to regular apprenticeship, clothed, fed, maintained, and worked under the same directing influence—schools which preserved traditions and recorded improvements.

*Fourth*, because the churchmen alone, at that time, extended their influence to a distance by founding establishments subject to the mother abbey. Hence, to the activity of religious orders the art of construction owes its rise from barbarism in the eleventh century. We will now consider how this rise took place, how it developed, and how it ended in the grand cathedrals of the thirteenth century.

**61.** However rich and powerful the monks might be, compared with the feudal lords and barons, they could not hope to build as the Romans built. They endeavored to erect solid and durable structures, but practised the closest economy, on account of the scarcity of materials and men.

To follow the Roman method of making their structures a mass of rubble between two faces of ashlar or brick, demanded more laborers than they had at their disposal. To build of enormous blocks of hewn stone, carefully cut and set, required means of transportation far beyond their facilities. So they pursued a middle course. For the principal points of support they used cut stone as a casing and filled in with rubble, and for other walls, a thin facing of ashlar enclosing a concrete filling made of pebbles and mortar.

The Roman buildings, by reason of the absolute stability of the different points of support, and the perfect concretion or solidifying of all the upper parts, presented immovable masses, as if they had been cut out of a single block. The Romanesque architects soon realized the fact that their buildings presented no such stable conditions. The piers, formed only with a veneering of solid stone and put together with a poor quality of mortar, and the walls, unbonded throughout their height, suffered from unequal settlement, causing ruptures, and, consequently, serious accidents. Towards the beginning of the eleventh century, these drawbacks became even more serious, for the Romanesque architects wanted to *vault* their structures. They had inherited a knowledge of the value of the Roman vault, but were unable to use it on account of the lack of sufficiently powerful support in the structures they had built. Their intelligence and ingenuity, however, made up for this lack of power and material. The Roman vault will sustain itself only when its supports are perfectly stable; for it is formed of a homogeneous crust of concrete, which, owing to its lack of elasticity, breaks to pieces if small crevices appear in its curve. Unable to furnish sufficiently stable walls to support vaults, as the Romans did, the medieval builders invented new methods of holding them firmly. The earliest of these attempts ended in failure, but from the very beginning, we can see the creation of a new system of building founded upon the principle of *elasticity*, in contrast to the principle of *stability*, or rigidity, practised by the Romans. The Roman vault, with but few exceptions, is built of rough stone concrete, and though sometimes strengthened by arches of *brick*, these arches are buried in the concrete and thereby become a part of it. In contrast to this method the Romanesque builders built their vaults not of concrete, but of hewn stone laid in mortar, but after the pattern of the old style Roman cradle vault, or, as it is sometimes called, a wagon vault, or barrel vault, as shown in Fig. 47, of which *a b d c* is the ground plan.

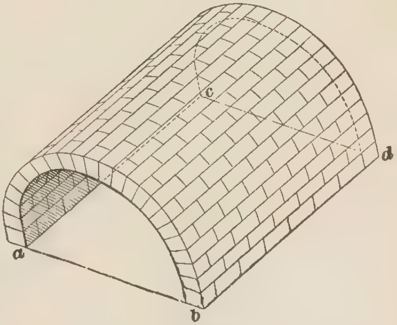

FIG. 47.

**62.** The medieval artisans at this time knew nothing of the laws of statics, and the thrust exercised by the arch upon the side walls being something entirely new to them, they neglected to provide sufficient means to withstand it. Consequently, at the end of the eleventh century, many churches and halls, which had been built and vaulted but fifty years, fell in ruins from the collapse of their vaults, and had to be rebuilt. These accidents, though unfortunate, bore good fruit; they were a lesson to the builders, and showed them that other means must be provided to accomplish the end they desired. These same builders knew that a groined vault, such as is shown in Fig. 48, exercised its pressure and thrust only at the four supports receiving the *skewbacks*, as the wedge-shaped abutting voussoirs, shown at *a*, *c*, are called; and, recognizing the advantage of the groined vault, they tried to replace the cradle vault with it, even in the naves composed of *oblong* compartments, and thereby bring all the weight on piers, which they hoped to be able to render stable. But new

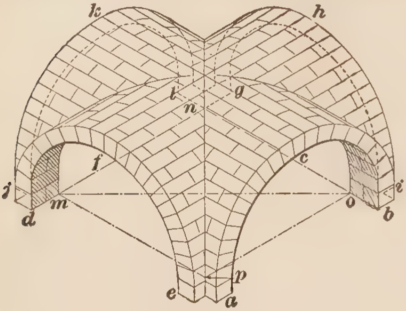

FIG. 48.

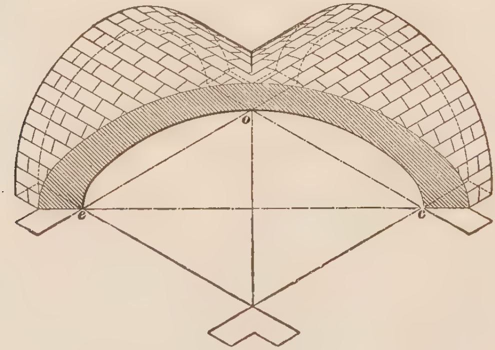

FIG. 49.

difficulties immediately arose. The Roman groined vault can be built only over a square space, as *m n o p* in Fig. 48, and it was necessary to find a new combination of groined vaults adapted to the form of a parallelogram.

The building of a Roman groined vault requires four semicircular centers, or templets, one for each end of the intersecting vaults *a c b*, *d f e*, *g h i*, and *j k l*, as in Fig. 48, and also two diagonal centers *m o* and *n p*, whose curve is not a semicircle, like the other four, but an ellipse, as shown in Fig. 49, in which the two front ends of the vaults are removed to show the line of intersection and form for the center *e o c*. In Fig. 50, let *A B* represent the diameter of a cylindrical vault and *A f B* its semicircular outline; then *C B*, drawn at an angle of 45° with *A B*, will represent the line on which the two vaults intersect. Now, as *o′ f′*, the height of the curve of intersection, is always equal to *o f*, the height of the semicircular outline of the vault, and *o′ C*, half the diameter of the curve of intersection, is greater than *o A*, half the diameter of the semicircle, it follows that *C f′ B* cannot be a semicircular curve. Simple as this geometrical problem is, it appeared too complicated for the Romanesque builders, and they could not produce a center with the curve

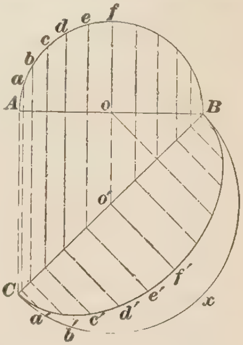

FIG. 50.

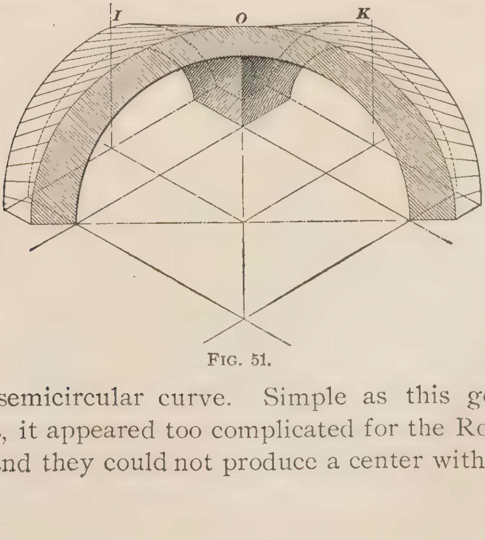

FIG. 51.

of the ellipse *C f′ B*. Accordingly, having described a semicircle upon the diameter *A B*, in order to cut out timber centers of the four arches generating the vault, they described a second semicircle *C x B* upon the diameter *C B*, in order to cut out the two diagonal centers. Thus, the keystone at *O* in Fig. 51, where these two vaults intersected, was on a higher level than the keystones at *K* and *I* in the generating arches, and the vault, instead of being the result of the intersection of two semicylinders, was a nameless compound of curved surfaces, slightly resembling a dome.

Upon this principle is based the whole system of vaulting during the middle ages; and, as all the details characteristic of Gothic architecture are indirectly traceable to its system of vaulting, we see that it would be impossible to design a Gothic building today without an intelligent understanding of the fundamental principles of its vaults. The above principle is also important on account of the fact that though they were trying to use the Roman vault, they modified it to such an extent that it became a different device entirely, and the builders of the middle ages were thus suddenly emancipated from all the bad influences of the Roman style, and left free to develop a new style from the raw material they had at hand, in the same manner that the Byzantine builders developed an original style, by careful study of the structural principles of the dome.

**63.** Having modified the Roman vault in this way, the next problem was to apply it to oblong plans, for the builders had already realized the danger of applying cradle vaults to wide spans. The Roman groined vault, applied to oblong spans, with a wide intersection, required the arch over the narrow span to be *stilted*, as shown at *e*, *f* in Fig. 52, and the lines of the groins *a b* and *c d* were not straight, but formed the compound curves *a b* and *c d*. This was a still more complicated problem for the Romanesque builders, but they solved it in the same manner as before, by cutting the centers, both for the ends and for the intersections of their vaults, in the form of a semicircle. But with this simple solution another difficulty arose: The lines of intersection, or groins, in the Romanesque vault were forced by circumstances to be straight in plan, as they were built over semicircular centers; but this produced such a warped surface in the vault covering itself, that the groins were projecting at the springing point and indented at the crown. Fig. 53 shows the earliest form of the Romanesque groined vault with the arch *c f g* over the end *r s* of the oblong space *r s u t*, and the arch *h i j* over the side *s u*. The intersecting curves *m n o* and *p n* over the diagonals *r u* and *s t* are semicircles, but the groins inside the vault do not produce a continuous angle on which a bead can be worked, as is the case when the arches are two intersecting cylinders, as in Figs. 48 and 52. A section through the corner on the line *a b*, Fig. 53, would produce an exterior angle, as shown at *v*, with the bead worked on the corner, but as you follow the groin up into the vault, the angle becomes more and more obtuse until it reverses itself and at *c d* becomes an interior angle, as shown at *w*. This was very unsightly, and the builders immediately set to work to improve on it.

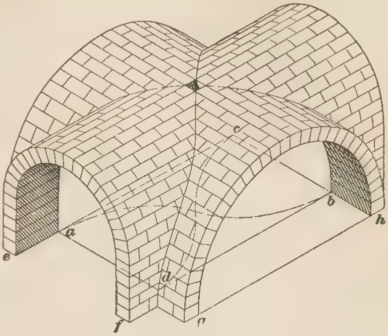

FIG. 52.

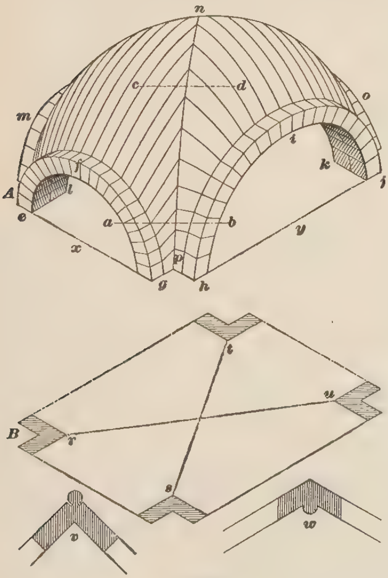

FIG. 53.

**64.** It was at this time that the pointed arch made its appearance, and there is little doubt that its invention or adoption was the direct outcome of the above cited difficulties in groined work. Fig. 54 shows a section of a cradle vault which has failed on account of its side walls *c* being too light to withstand the horizontal thrust. The dotted line shows the original position of the wall and vault, and the top of the wall *a′ b′* now occupies an altered position, as at *a b*. It is therefore clear that the vault has failed by parting at the crown on the inside, or intrados *d*, and by breaking at the haunches on the outside, or extrados *e*. When the walls separate enough to let the keystone *f* drop out, the entire crown of the vault will fall. It is very evident, then, that if the crown of the arch were higher, as at *o*, it would have much farther to settle before the keystone would drop out, and the arch would be much more likely to fall by the walls *c* tipping over entirely, than by the crown of the arch falling in. Therefore, by striking an average between the point where the arch crown would stand till the walls fell, and the point where the walls would stand till the arch fell—or, in other words, proportioning the parts of the arch so that its own strength for support is equal to the strength of the walls to resist its thrust—we have an arch of the form shown in Fig. 55, which is simply the pointed arch that marks the dawn of the Gothic style. It was to this end that all the experiments and failures of the Romanesque builders led, and it was in this arch that all their difficulties were overcome. Excessive horizontal

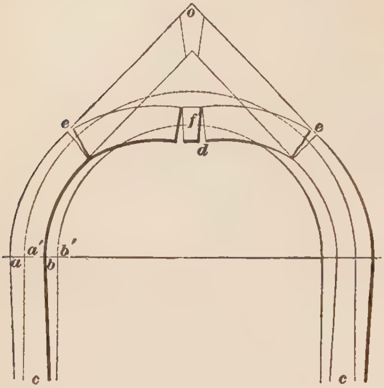

FIG. 54.

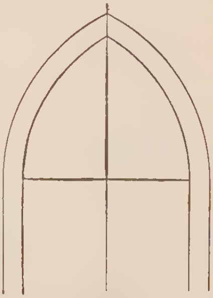

FIG. 55.

thrust is done away with, intersecting vaults of any size are possible without difficulty or danger, vaults over oblong spaces are as simple as over square plans, groined vaults are formed with ribs that are straight in plan, and the curves at the intersections, or diagonals, are always semicircles.

**65.** In Fig. 56 we have a pointed groined vault with the groins built upon semicircular centers *c d e* which are higher at their middle point *o* than the crowns of the pointed arches *a* and *b*. The crown of the vault is, therefore, curved in the same manner, though not so much as the crown of the vault in Fig. 53, but the groins in the pointed vault are perfectly straight throughout their length and can be worked or beaded as desired. As said before, the method of building these arches was not that of the Romans—a solid concrete mass with brick arches embedded in the concrete to give it strength while it was setting; but, on the contrary, the Romanesque vault was composed of small panels or slabs laid upon the ribs or groins for support. At each end of the vault an arch was turned and also at the intersection or groin, and upon these arches boards were laid, and the mason work of the vault was then built over the boards, the arches remaining in place and thereby forming a sort of permanent center. These centering arches soon became more and more numerous as the vaulting became more complicated; and in order to ornament them, they were carved into rich moldings and their intersection covered with a *boss*, or rosette, carved in the form of a bunch of leaves or flowers.

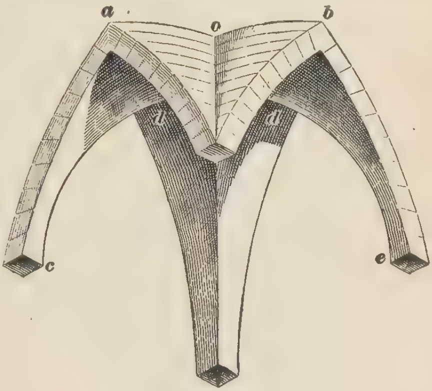

FIG. 56.

Fig. 57 illustrates the constructive system of the late

Romanesque or early Gothic church; the transition from one style to the other being so gradual that an exact line of distinction cannot be drawn. The walls *a*, of the nave *h* are supported upon the columns *b*, and the roof over the nave is vaulted in the Gothic system just explained. The groins, or ribs, of these nave vaults rest on the piers *c*, which are directly over the columns *b*, and the thrust of the nave vaults is carried by the flying buttresses *d* across the aisle vaults *e* to the solid buttresses *f*, the lower portion of which also receives the thrusts from the aisle vaults at *g*, thus illustrating the two great principles of Gothic construction: concentration of strains upon isolated supports, and balanced thrusts. The former of these principles was made possible by the substitution of the groined for the barrel vault, which led to the concentration of masonry at the points where the groins rested, and the building was constructed as if upon legs, as may be seen in Fig. 57.

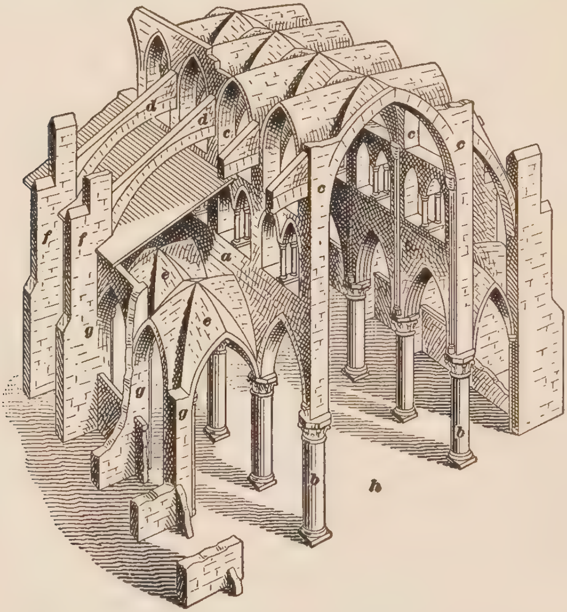

FIG. 57.

**66.** The second of these Gothic principles of construction is in direct opposition to the Roman system of vaulting, where the thrust of the vault was resisted entirely by the inertia of a mass of masonry piled against it in the abutments. In Gothic architecture, thrusts were as far as possible resisted by counter thrusts, and the final resultant pressure was transmitted by flying buttresses to the external buttresses at convenient points.

The pointed arch did away with the tremendous thrust of its Roman ancestor, but it had some thrust of its own, and in order to diminish this thrust sufficiently to make a light wall or pier a safe support, the pointed arch would be too high in proportion to its width to look well. Here, then, was a defect in this new form which had emancipated the middle-age builders from their most dangerous difficulties. Man no sooner admits a principle than he discovers its imperfection.

**67.** During all the Romanesque period the architects had made vain attempts to reconcile two apparently contrary principles, namely, economy of material with a modified form of the Roman vault. The success they achieved was in the invention of a new vault, descended from, but in no way related to, the massive construction of the Romans. In some parts of France the builders adopted the Byzantine form of construction, as shown in the Church of St. Front, at Perigueux, built in the tenth century. But the constructors of this church were no such intellectual men as their northern neighbors. The constructors of St. Front erected their church as a molder might do, reproducing forms and shapes whose structures they did not comprehend. For example, the pendentives which support the domes of St. Front are faced with courses of stones set in corbels whose beds are horizontal and not perpendicular to the curve of their arch. If these do not fall inwards, it is because they are held by mortar, and adhere to the masonry, which gives them their concave form. Such a building is only an imitation of other existing forms, of whose geometrical reason its builders had no understanding. The pointed arch, however, was the direct development of the efforts of the Romanesque builders to build permanently with the materials they had at their disposal.

**68.** The plans of the churches in western Europe differed but little from that of the Roman basilica, where the first Christian services were openly held. These services consisted at first of simple explanatory lectures to the assembled multitude, but as the faith spread they became more elaborate and complicated, until finally the priest and the laity became divided into totally different classes and changes became necessary in the arrangement of the plan to suit these advanced forms. The apse alone was at first appropriated to the use of the clergy, but subsequently the entire *dais*, or raised platform on which the altar stood, was separated for them by railings, called *chancelli*, from which is derived our modern term *chancel*.

The choir became extended in front of this, and contained two pulpits, called *ambones*, from one of which was read the Epistle, and from the other the Gospel. These changes took up so much of the previously available space that it was necessary to lengthen the nave and aisles to make room for the congregation, and thus the atrium and narthex became absorbed, while in their place appeared the elaborate porch so characteristic of the Romanesque period.

The flat wooden roof became replaced with a groined vault, or occasionally, as in France, by a cylindrical or barrel vault, and sometimes by a series of cupolas, as in the East. The plainness of the walls above the columns of the nave was relieved by a cornice, above which was inserted a number of windows. Similar but smaller windows pierced the side walls and even the apse, and over the porch, as well as in other prominent locations, were large circular or wheel windows, without moldings at first, but in later buildings richly ornamented, as shown in Fig. 58. The classic orders were gradually replaced with columns and capitals representing flowers and leaves of different kinds, as well as human and animal heads, treated with great boldness and freedom. Between the years 1175 and 1220, Romanesque architecture reached its fullest development.

The eastern art and eastern forms were widely adopted by the western architects, and the Roman arch was abandoned for the pointed and foliated arch, while clustered columns and richly carved capitals expressed a change of feeling and abandonment of all classic traditions that ended in the birth of the Gothic style.

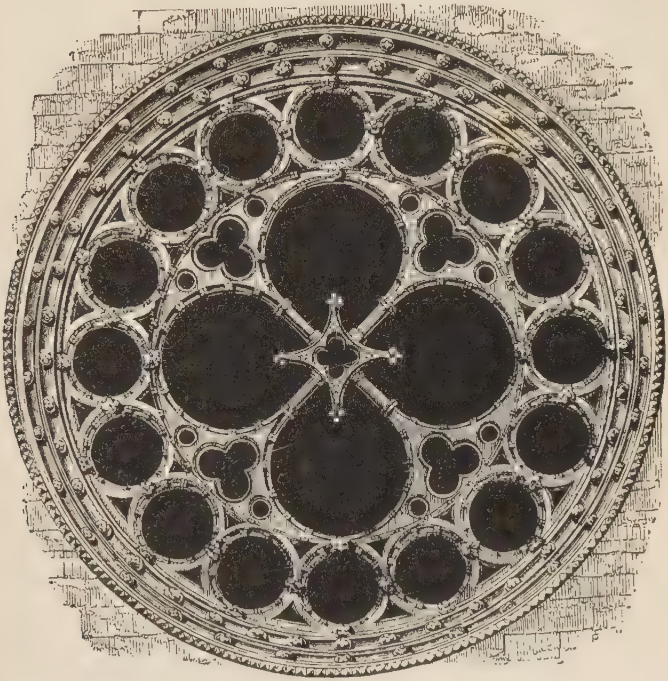

FIG. 58.

## THE GOTHIC STYLE.

**69.** The term **Gothic,** at first applied in derision by the architects of the Renaissance period, is now accepted as the name of the style of architecture that flourished in western

Europe from the middle of the twelfth to the end of the fourteenth century. It varied under local influence in different countries, but its distinguishing characteristics were everywhere the same. Long vertical lines and high pointed gables superseded entirely the horizontal cornice and long low pediment, while the introduction of the spire, buttress, pointed arch, and clustered column opened a new field for decoration and sculpture impossible in classic art. Each of these changes was the result of a structural necessity, and each had a meaning and purpose of its own.

The variations in the Gothic style, which existed in different parts of Europe, were due partly to geographical location and partly to traditions. The style was never perfectly developed in Italy and southern France as the numerous classic monuments and the extensive maritime relations with Rome and Byzantium prevented an independent progress in the new direction. In Yorkshire, England, however, there was a steady progressive development uninfluenced by any classic tradition, and unrestrained by scarcity of desired building material. In northern France and in Germany the style maintained an independent development, but was influenced more or less in France by the close proximity of England, and in Germany by the lack of stone with which to build.

**70. English Gothic** architecture may be divided into three distinct periods; namely, the *Early English*, from 1175 to 1272 A. D.; the *Decorated*, from 1272 to 1377; and the *Perpendicular*, from 1377 to 1483; each period being about one hundred years in extent, though the transition from one style to the next succeeding was so gradual that no exact dividing date can be set.

The **Early English style** includes the transition from the Romanesque to the Gothic, and the earliest structures were French in their origin, but thoroughly English in their development. The round arch of the Romanesque gave way to the pointed arch of the Gothic style, and the window openings became longer and narrower than their Romanesque antecedents. For this reason it was necessary, in order to secure adequate light and ventilation, that they should be arranged in groups of two, three, or even occasionally four together, and the walls on the inside of the building were splayed, so as to combine the group in one window on the inside, as shown in Fig. 59, while on the exterior they were treated as individual openings, as shown in Fig. 60. The

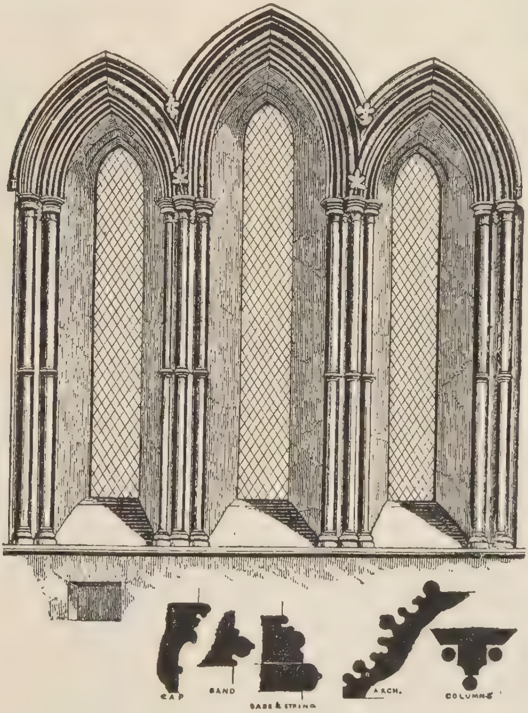

FIG. 59.

intersections of the splayed jambs were finished with small round columns, which supported a group of moldings over the pointed window head, as shown in Fig. 59. When three windows were thus grouped, the middle one was usually longer than the other two, but in a group of two they were both the same size, and included under one arched dripstone, as shown in Fig. 61, while the wall under the point of the arch, was pierced by a trefoil or quarterfoil opening, as shown. Three windows were grouped under one dripstone as the style advanced, and their mullions, or dividing bars, were split and carried to the top of the opening in curved lines parallel to the opposite sides of the arch, as shown in Fig. 62, thus giving the appearance both within and without of a single opening divided by bars.

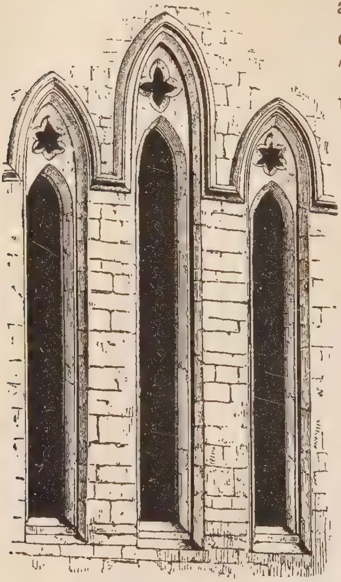

FIG. 60.

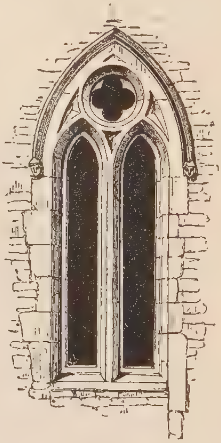

FIG. 61.

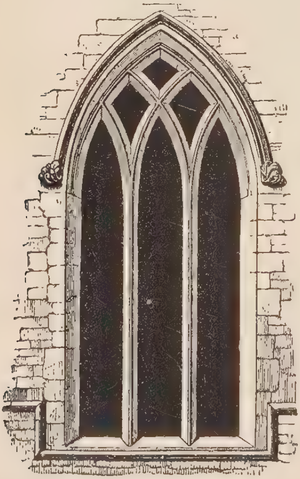

FIG. 62.

This treatment of the window heads is called **tracery**, and the structural system of the window tracery furnishes a key by which each period of English Gothic architecture can be readily determined. The above examples are characteristic of the Early English period, particularly Figs. 59 and 60, which are called *plate tracery*, where the openings are cut through a flat wall surface, in distinction from *bar tracery*, where the openings are outlined by bars or split mullions, as in Fig. 62. Bar tracery made its appearance towards the end of the Early English period and shows the tendency of the style toward the Decorated period which followed.

**71.** Early English door openings were first arched with the round arch of Romanesque origin. Later they became pointed, and were often divided in the middle by a column and treated like a pair of lancet windows, such as are shown in Fig. 61. Square-headed doors were occasionally used, but their corners were corbeled out, as shown in Fig. 63, while a wide chamfer was cut from the angles of the jambs. Occasionally a door with corbeled corners was arched over with a round arch, giving the head the form of a trefoil, but examples of these are rare, and confined to distinct localities.

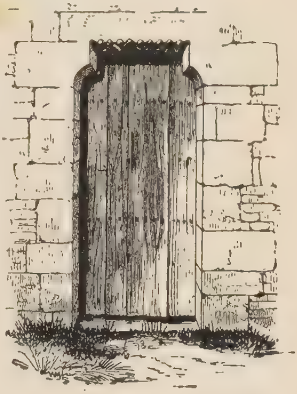

FIG. 63.

**72.** We now come to that detail which is most characteristic of all Gothic construction; i. e., the vault. Early English vaults are bold in their structural design; spanning large openings without apparent assistance, and are simple and devoid of ornament, except the molded ribs, which are carved on the angles of the groins, and the foliated *boss* which marks the intersection of the ribs. Fig. 64 shows a portion of the vaulting in the cathedral at Salisbury, England, the plain treatment of which is characteristic of this period. These large vaults, though simple in their apparent construction, required complicated buttressing to maintain them in place. The buttresses projected very boldly from the wall, as shown at *g* in Fig. 57, but were stepped off toward the top, as shown at *f*, and the great flying buttresses *d*, which in the Romanesque style were always concealed under the roof of the side aisles, are now carried high above the roof to receive thrust of the large vaults over the nave. The buttresses were seldom ornamented and the character of the whole period is more expressive of thorough, systematic construction than it is of progressive development of ornament. The Early English architects built for permanency, and it was the succeeding period which inherited this almost perfect construction, and devoted its energies to the beautifying of it.

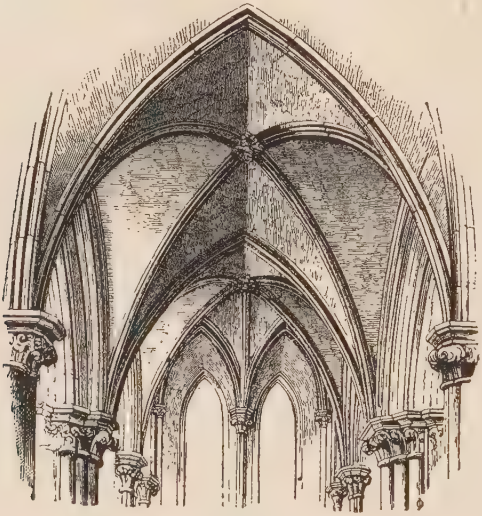

FIG. 64.

**73.** The **Decorated style** is distinguished by wider windows used singly, and divided by narrow mullions, or bars, instead of the narrow windows arranged in groups, as in the previous style. The tracery in the tops of these windows takes the forms of circles, trefoils, quarterfoils, and other geometrical shapes, which are not arranged perpendicularly, each over the one below, but are usually so placed that each form occupies a position above and between two similar forms beneath. Thus, it will be observed in Fig. 65 that the window is divided into three **days**, or openings, by narrow mullions which divide and close each day in a pointed arch. Two foliated triangles then rest on the points of these arches, and a circle is poised between the vertices of the triangles. A vertical line drawn through the center of any one of these forms would not cut the center of the next below—a feature which is peculiar to the Decorated period. The jambs and mullions of the windows were richly ornamented, particularly with a device known as the *ball flower*, which is shown used to great excess in Fig. 66. This ornament is characteristic of the Decorated period, its more sparing application being shown in Fig. 67.

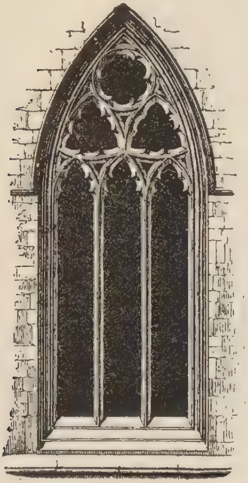

FIG. 65.

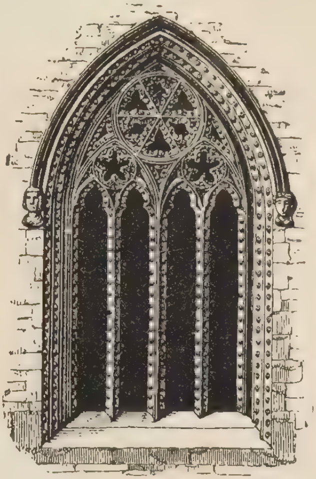

FIG. 66.

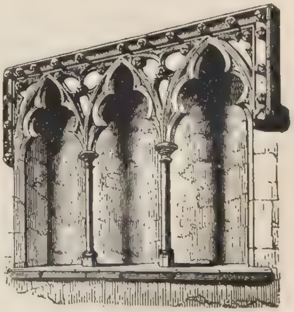

FIG. 67.

Circular, or **rose**, windows reappear in this style, though the details of their tracery are vastly more complicated than in the Romanesque. Circular subdivisions, as shown in Fig. 58, never exist in rose windows of this period, except occasionally at the center, and then only as starting points for straight radial bars, which, like the mullions of the vertical windows, split near their outer extremities and enclose several eccentric geometrical forms, as shown in Fig. 68. The doorways were large and richly ornamented, and were usually protected by arched dripstones, supported on small carved heads, usually portraying the king and the bishop, or other prominent prelates, as shown in Fig. 69. Small niches arranged as seats, called **sedilia,** were introduced into blank portions of the wall during this period. These were sometimes divided by small columns connected with foliated

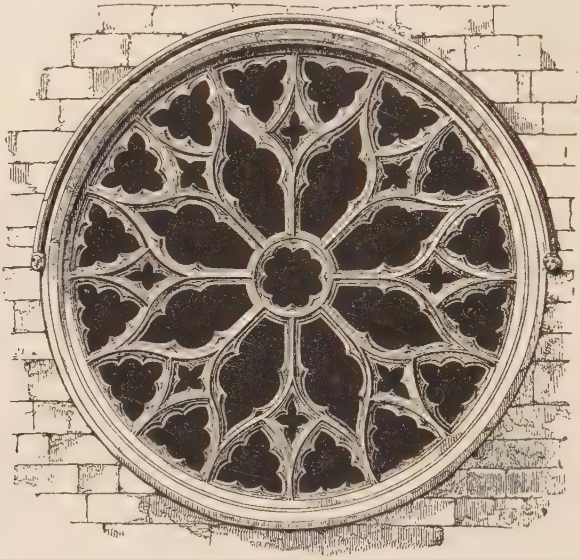

FIG. 68.

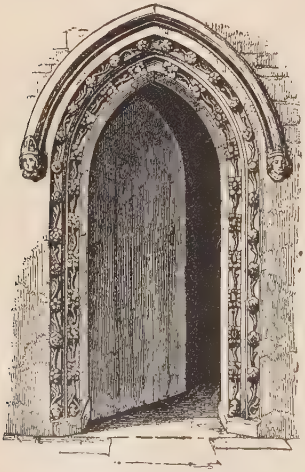

FIG. 69.

arches, as shown in Fig. 67. The vaults became more complicated than in the Early English period, and instead of confining the ribs to the angles of the groins, extra ribs were introduced and spread over the surfaces of the vaults to increase the decorative effect, as shown in Fig. 70. The columns supporting these vaults were no longer single piers, but were arranged in groups, or clusters, carrying the lines of the vault ribs down to the plinths, or bases, on which the shafts rested.

The exterior features, such as buttresses and flying buttresses, became much more ornate, as shown in Fig. 71.

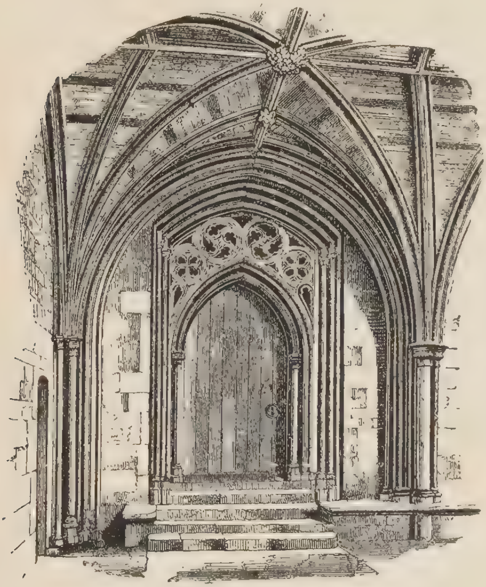

FIG. 70.

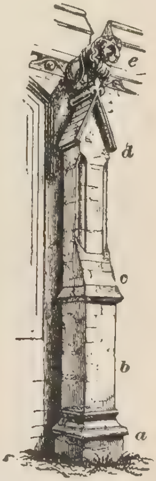

FIG. 71.

The former were usually divided so as to consist of a pedestal *a*, which receded to a smaller section at *b*, to which the front sloped back as at *c*. The top of the buttresses were sometimes gabled as at *d*, and a *gargoyle*, or ornamental spout, delivered the water which accumulated behind the parapet *e*.

**74.** In the **Perpendicular style** the tracery becomes more and more complex, and differs from the former type by its tendency to assume the perpendicular form. The mullions are carried straight to the window head, as shown in Fig. 72, which is a view of the west front of St. George's Chapel at Windsor. The tracery is composed almost entirely of vertical elements. This perpendicular feeling showed itself not only in the traceries, but also in the general design of the entire building. Long, narrow panels ornamented the buttresses, as shown in Fig. 73, while the windows in the side walls were treated simply as openings in the panel work. The porches were unusually elaborate at this time, and highly enriched with pinnacles, buttresses, panel work, etc., as shown in Fig. 74. The ogee and crocketed gable are the distinguishing features of the **Tudor period,** which was the latest phase of the Perpendicular style, and is so called from the royal house of Tudor, then

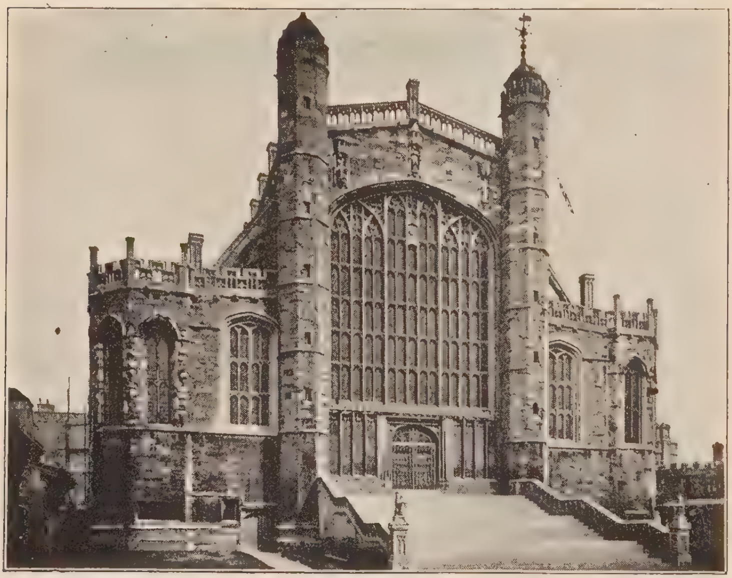

FIG. 72.

reigning. The vaulting in this period reaches its most complex form, the interlacing lines, or ribs, completely covering the soffit of the vault. In Fig. 75 is shown a portion of the vaulting of the Henry VII Chapel in Westminster Abbey, a most elaborate example of *fan tracery*, so called from the fact that the ribs rise from the springing of the vault and from intermediate pendants, and diverge regularly like the radial ribs of a fan.

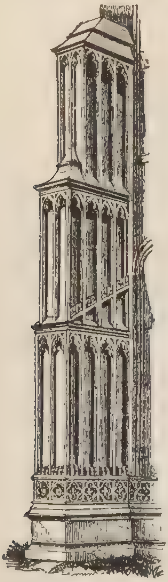

FIG. 73.

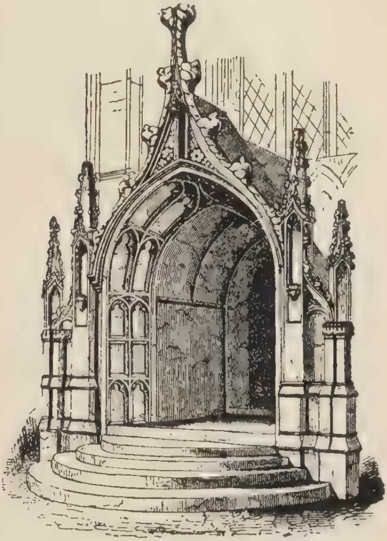

FIG. 74.

**75.** After the Tudor period the Gothic loses its purity. We have seen it develop from the simple Romanesque forms to the complex designs at the end of the Perpendicular period, when it reached its limit, and a reaction naturally set in. From this time we find Gothic structures tainted with classic and other foreign detail. This occurred, not only in Great Britain, but also on the Continent, where the change took the name of *Renaissance*, but in England it was first called the *Elizabethan style*, or *late Tudor*. This incongruous mixture of Gothic and classic features continued to the middle of the eighteenth century, when Gothic was revived in England, and has been the prevailing style down to the present day.

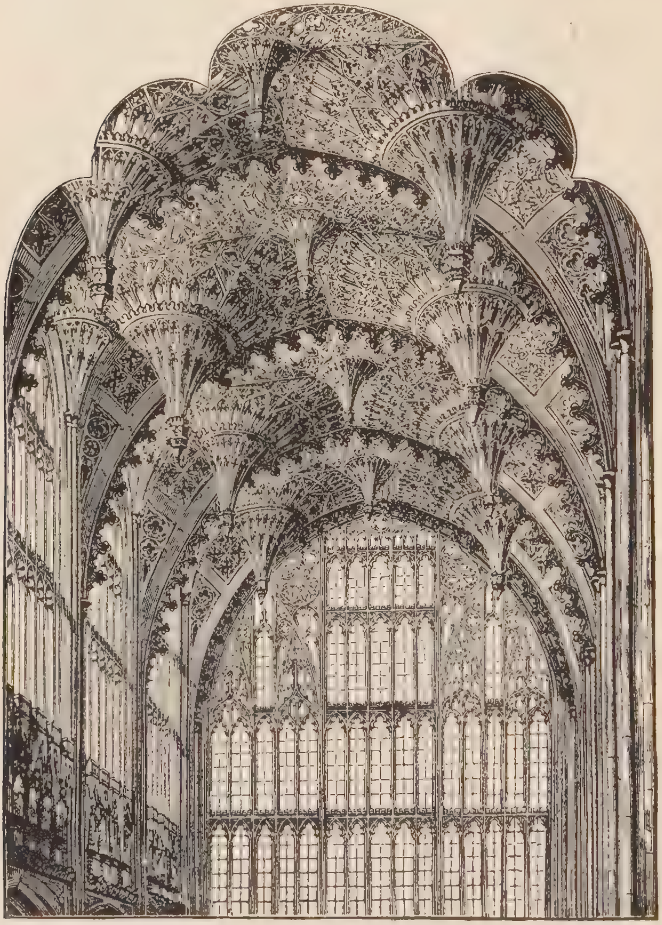

FIG. 75.

**76.** The peculiarity of all English cathedrals compared with those on the Continent is their extraordinary length in proportion to their width. The length of pagan temples was generally twice the width, while the length of Continental cathedrals was four times the width, but the English churches exceeded even these, their length being from five to six times their average width.

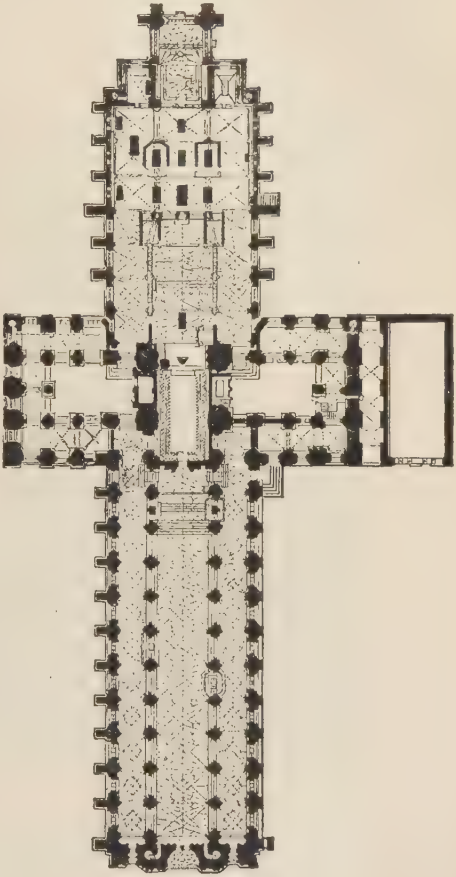

FIG. 76.

Winchester Cathedral is 556 feet in length and is 85 feet in width. It was remodeled in the tenth century and again in the eleventh, and is now the longest and finest of English cathedrals. A plan of the cathedral is shown in Fig. 76, the dotted lines on the floor area representing the lines of the groins of the vaulting overhead. One of the most valuable buildings for the study of English Gothic architecture is Canterbury Cathedral, as it shows work during the entire period of transition from Romanesque to Gothic.

Westminster Abbey, founded in the eleventh century, Fig. 77, illustrates the transition from the Early English to the Decorated style. It is another most important structure to the architectural student. Its extreme length, including the Henry VII Chapel, the interior of which is shown in

Fig. 75, is 530 feet. The height of the western towers is 225 feet. The Henry VII Chapel was completed in 1509, covering the site of the original lady chapel, and contains the body of the king whose name it bears. It is the finest piece of work in the Tudor style in Great Britain, and is at once one of the stateliest and daintiest monuments of Europe, both as a chapel and sepulcher. In Westminster Abbey on Christmas day, 1066, William the Conqueror was crowned first king of England, and each of his successors, including Queen Victoria, received coronation in the same place.

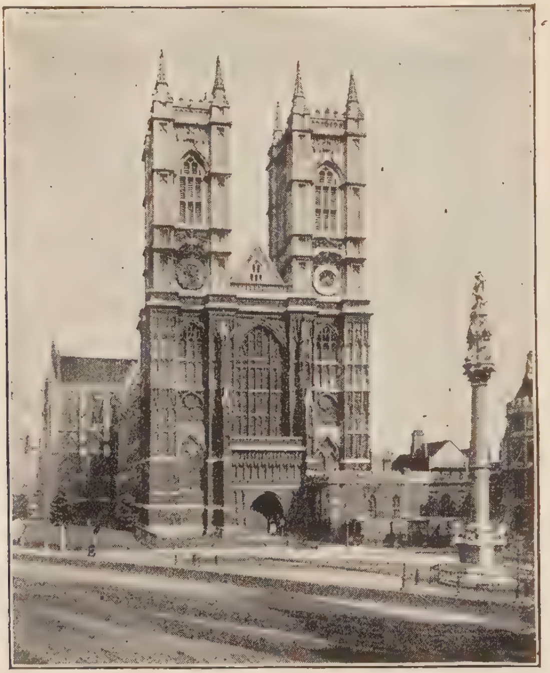

FIG. 77.

**77.** In France, the progress of Gothic architecture was much affected by the political divisions of the country. The southern part was populated by a Romanesque people, whose architecture was very slightly affected by their barbarian conquerors, while the northern portion was occupied by the Franks in such numbers as to materially alter the status of the race. So, in a straight line from south to north, the architecture gradually advanced from simple Romanesque on the Mediterranean to Flamboyant French Gothic on the English Channel. Neighboring provinces also differed greatly from one another. Normandy, for instance, in the twelfth century was an English province, and the difference in style between this and other districts was greater than between Normandy and England. In a considerable part of southern France, the Byzantine influence was introduced by a colony of Greek or Byzantine merchants. In Perigueux, the Church of St. Front was distinctly a Byzantine edifice, modeled after St. Mark's, at Venice. Many other Byzantine churches existed in this province, as well as in Aquitania.

**78.** The **Early French style** differs in many respects from the Early English, although agreeing with it in general character. The French churches are much larger and higher than those in Great Britain, and the tendency of the architects seemed to be in the direction of making each new nave higher than its predecessor, until every idea of proportion in other parts was sacrificed to it. Immense flying buttresses became necessary to support these lofty roof vaults, but the towers at the west entrance and at each end of the transept were very little higher than the ridge of the roof.

**79.** The period of transition from Romanesque to Early French occurred in the reign of Philip II (1179 to 1223), although it began during the reign of Louis VII, under Abbe Suger. In England the change took place under Henry II (1154 to 1189), and the new style was fully established under Richard I (1190 to 1200). In both countries the examples built during the transitional period are so numerous that it is difficult to say which has the advantage. The French churches have the greater height, and in them is made a more general use of vaulting. The arrangement of numerous chapels in the apse afforded an excellent field for the display of ingenious and complicated vaulting. The Cathedral of Notre Dame at Paris, founded in 1163, is of this period. The front elevation is shown in Fig. 78, and it is of interest to know that its erection was contemporaneous with Lincoln Cathedral in England.

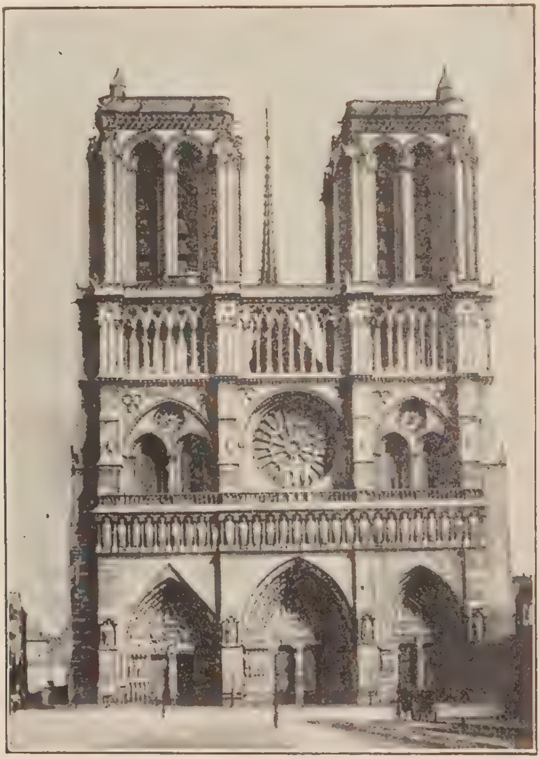

FIG. 78.

**80.** Early French columns are usually plain and round, with capitals of a classic character, somewhat resembling the Corinthian or Composite, while the arches have a plain square soffit with a chamfer on the angle. The windows are either plain lancets or consist of two lights under one arch with the head frequently pierced by a circular opening, at first plain, but afterwards foliated. As the style advanced, the thickness of the space between the two lancets gradually diminishes until the later examples appear in fine bar tracery. French windows have fewer moldings and much less splay than their English neighbors, but their doorways are much larger and finer, and are often richly sculptured with full-length human figures, as shown in Fig. 79, which is the central door of the Church of Notre Dame.

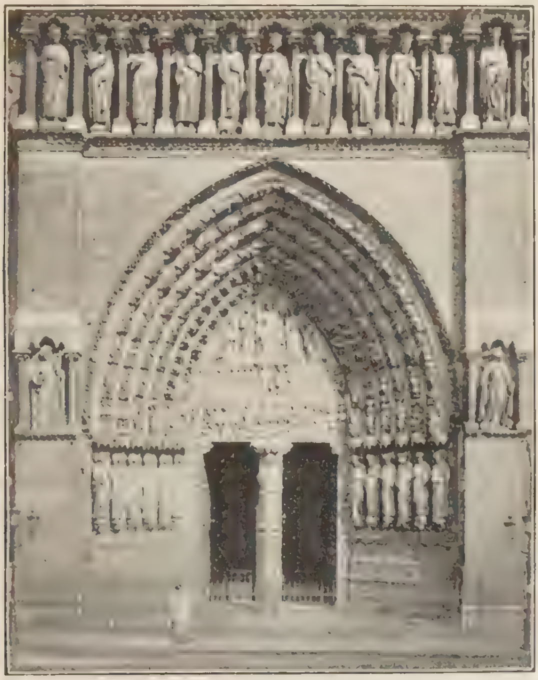

FIG. 79.

**81.** The Decorated style in France does not differ materially from the same style in England. There are few large buildings of this style in France, the greater part of the cathedrals having been rebuilt in the thirteenth century or continued in the same style throughout the fourteenth. The tracery shows less variety than in England, consisting almost exclusively of trefoils and quarterfoils until the advent of the Flamboyant style.

**82.** The **Flamboyant style** developed from the Decorated in France much more rapidly than did the Perpendicular in England; it also differs very materially from the latter, and has few features in common with it, though obviously contemporaneous. The variety of Flamboyant work found in different provinces is almost endless. The window traceries frequently take the form of a large *fleur de lis*—the French term for flower of the lily—or sometimes a heart, or the heraldic device of the family that caused the building to be erected. The windows are the principal guide and key to the style, and are distinguished by their flame-like tracery, from which the term Flamboyant is derived.

In the French Gothic style the crockets are larger and more separated than in English work, and *battlements*, or indented parapets, are never used at all. The Flamboyant style continued throughout the fifteenth and sixteenth and part of the seventeenth centuries, becoming gradually more mixed with the revived classic details, until superseded by the Renaissance.

**83.** Gothic architecture in Italy is unique. Its character is entirely different from the style as we find it in northern Europe, and the plans, groupings, and treatment of the details all show the influence of the surrounding classic monuments and ancient Roman traditions. In northern Europe Gothic architecture was developed through centuries of church building. In Italy we find but one cathedral of importance in the Gothic style. In England the plans were irregular and unrestrained; the elevations showed abundance of detail and ornament, but the lines were vertical, and horizontal string-courses, cornices, etc., where they did occur, were broken or stopped against vertical buttress lines in order to prevent them from undue prominence. Columns were used exclusively as an internal feature; window openings were large and numerous, and were usually pointed and richly traceried.

Contrary to all this we find the Italian Gothic plans very regular (usually rectangular), owing to the influence of the ancient Roman buildings. The elevations are most elaborately detailed, but without any attempt to preserve the predominance of vertical lines, or to prevent the prominence of horizontal members. Columns and colonnades appear as exterior features everywhere, and the windows are small and regularly grouped.

**84.** One of the earliest Gothic buildings in Italy is the Palace Vecchio at Florence, shown in Fig. 80. This building, erected in 1298 A. D., was originally the town hall, or seat, of the city government, and consequently is built in a severe and fortress-like style. It is especially remarkable for its tower which rises 308 feet above the pave, and overhangs the wall of the building nearly 6 feet, being supported

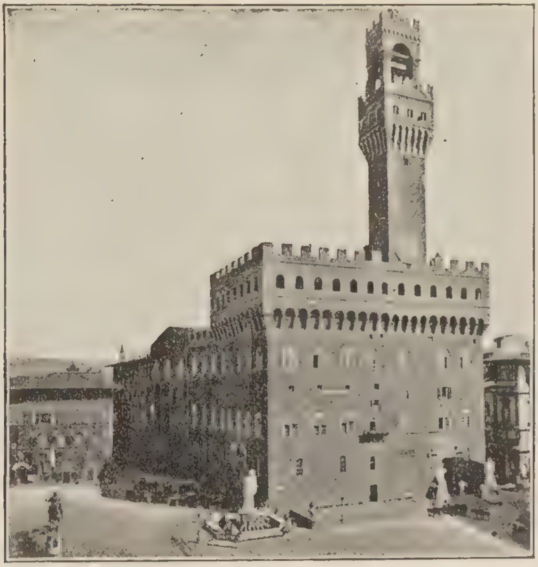

FIG. 80.

by the powerfully corbeled cornice. The windows, it will be observed, are small, regularly spaced, and though possessing foliated heads, are entirely devoid of tracery

In Venice, however, the window details are richly carved and show beautiful examples of both plate and bar tracery.

**85.** The Ducal Palace, shown in Fig. 81, is the principal building in the Venetian Gothic style, though it has been submitted to many alterations since it was built. The two-storied arcade dates from 1354, and originally stood out from the main edifice, which was widened in the fifteenth century, and the upper walls of white and black marble, in a checkerwork design, were erected over the columns. These arcades are beautiful designs, combining massive strength and grace in a manner unseen in any of the northern and western Gothic edifices. The columns have no bases, and in the first story are somewhat clumsy, but the upper arcade and tracery are as delicate and graceful a piece of work as can be found in the country. The proportions of the building as a whole are

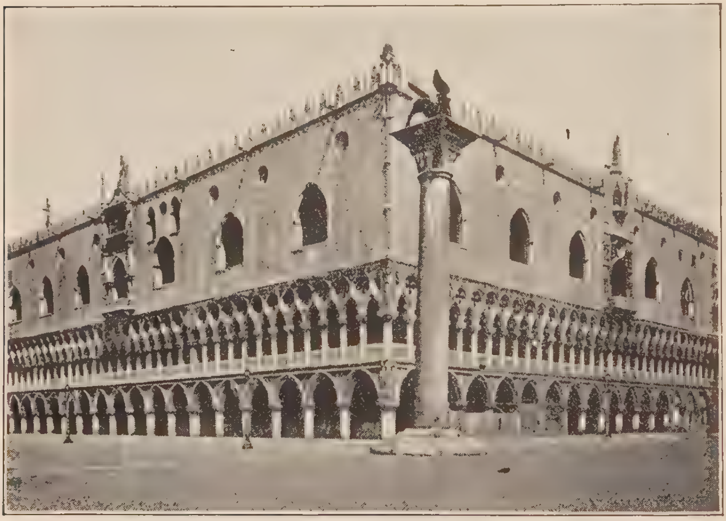

FIG. 81.

not pleasing, however; the top story appears heavy and out of place with the delicate carving beneath, while the subdivision of the facades into three horizontal elements so nearly the same width, is not in accordance with the rules of good architectural composition.

**86.** The Foscari Palace, shown in Fig. 82, is a much smaller building, but the grouping of the parts are so admirable that a most pleasing effect is obtained. The double arcade and balconies of white marble in the center, flanked on either side by the darker-colored brickwork, produces a most pleasing contrast, as well as a feeling of repose in the parts, by the careful grouping of the windows, and the judicious exposure of plain wall surface.

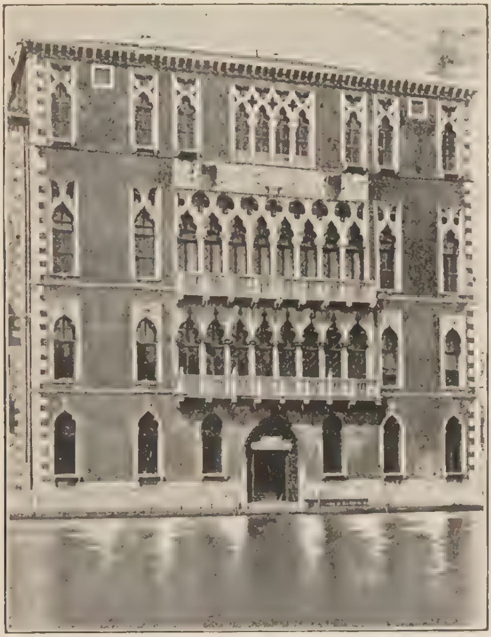

FIG. 82.

**87.** A still smaller building, but withal a masterpiece of the Venetian style, is the little Palace of Contarini Fasan, also known as the House of Desdemona, shown in Fig. 83. This little structure, by the proportioning, grouping, and treatment of its details, expresses more clearly than any other building in the style, the wide adaptability of the Venetian

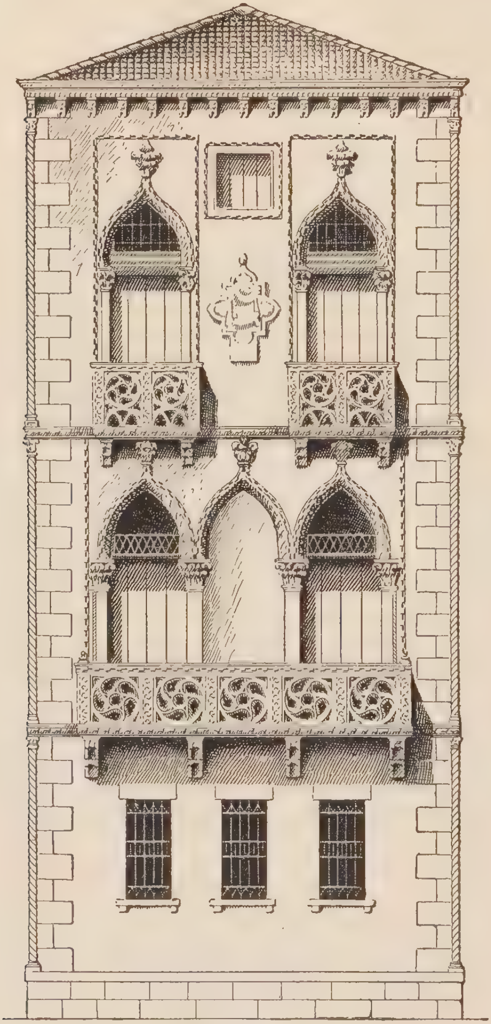

FIG. 83.

Gothic to residence work, and at the same time shows the wide field for elaboration and carving presented by the numerous loggias and balconies.

**88.** The cathedral at Milan, though erected in 1440, cannot be properly considered as an Italian Gothic structure. Built entirely of white marble, gorgeous in its decorations, and more lavish in the sculpture of its spires and pinnacles than any other building in the world, it fails to command the admiration it deserves on account of the monotony of its detail and the lack of purity of its style. Designed by a German architect, and erected under the supervision of an Italian artist, it possesses none of the national characteristics peculiar to Italian Gothic, while the classic tendency of its details detracts from the meritorious work of its German designer. It is the second largest of the medieval cathedrals, however, and a beautiful structure, though its architecture fails to show any progression in the Italian style.

**89.** *German Gothic* is similar, though inferior, to the French style, but possesses many original characteristics. The traceries and details are thicker and heavier than the French, and the plans of the cathedrals are shorter and wider in proportion. In eastern Prussia and other localities where stone was scarce, many Gothic edifices were erected in brick, which gave a character to the style not found elsewhere.

### DOMESTIC ARCHITECTURE.

**90.** A false impression prevailing in the minds of the majority of students is that Gothic architecture was confined entirely to churches and other ecclesiastical edifices; the fact is that this style pervaded every building that was erected in western Europe during the thirteenth and fourteenth centuries. The castles and residences of the nobility formed an important part of the architecture of the middle ages, and established details and peculiarities of plan which have been retained in a more or less modified form down to the present day.

Though these castles were primarily military posts, they were at the same time the official residence of the lord or baron who governed the territory, and while they were built in accordance with the medieval ideas of defense, their planning is expressive of the feudal relation of the vassal to his lord, who, while he exacted the former's services, also maintained him, under the same necessity he felt of sheltering and feeding his cattle—in order to fit him for work.

**91.** In general plan, the feudal castle consisted of a *keep*, or central tower, surrounded by a *moat*, or ditch filled with water, on each side of which was a large enclosure, or courtyard, known as the inner and the outer *bailey*, the entrance to the keep being from the former. The stables, barns, granaries, etc. were generally in the outer bailey, but clustered around the keep, which was the final place of refuge in case of an assault. In its lower stories the keep contained storerooms for provisions and dungeons for prisoners, and in the upper stories lived the lord and his family, especially in time of danger.

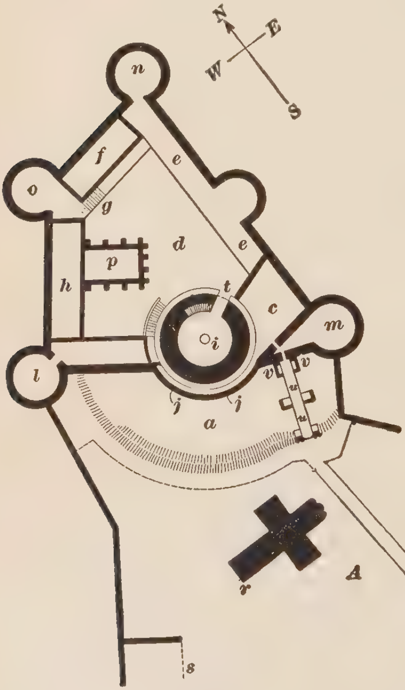

FIG. 84.

In Fig. 84 is shown a plan of the Castle of Coucy, near Laon, France, which was built in the thirteenth century and is typical of the style of residence of the nobleman of that period. Fig. 85 shows the general appearance of the exterior of the castle, and the letters of reference thereon mark the same details as are indicated by similar letters on the plan.

At *A* is shown a portion of the outer bailey, containing the chapel *r*, the stables *s*, and other buildings not here shown.

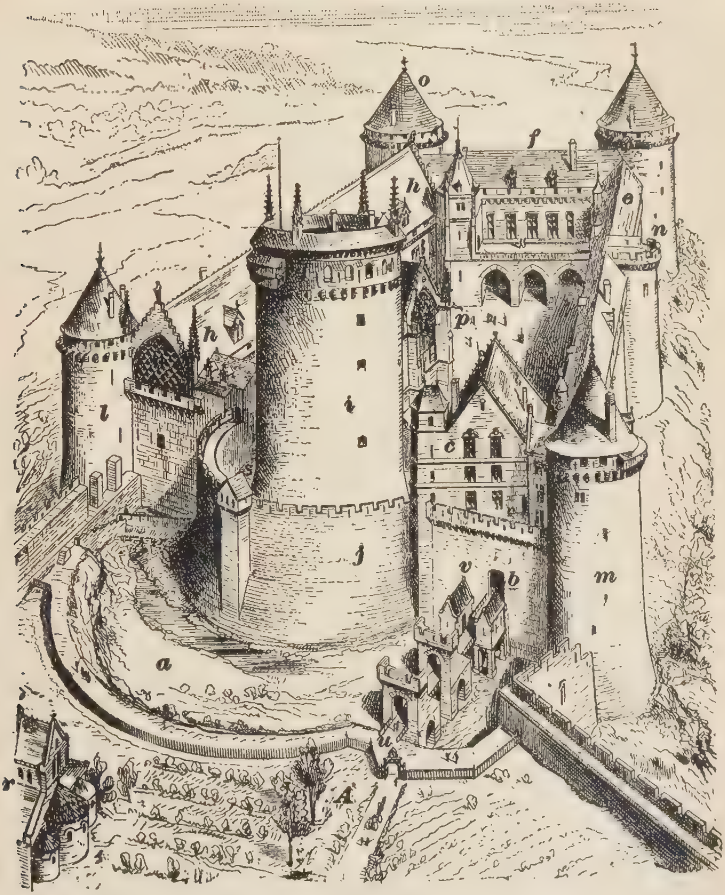

FIG. 85.

The entrance to the castle proper, shown at *b* in Fig. 85, is approached over two drawbridges *u*, *u*, which are defended by the guard rooms *v* and a double portcullis, or vertical sliding gate, within. These drawbridges cross the moat, or *foss*, *a*, which in time of danger is filled with water to prevent an attacking party from undermining the walls. Beyond the entrance *b* is a vaulted guard room *c* with sleeping apartments above, and beyond the guard room is the inner bailey *d*, bounded on the east by the heavy curtain wall, which is surmounted by the covered buildings *e*, erected for the shelter of men who are placed there to defend it during attack. On the north side *f*, where the ground slopes off so suddenly as to make it an unlikely point of attack, are located the family apartments, reached by a stairway shown in the plan at *g*.

The apartment *h* on the west side is the great hall, which was the principal living room of the house, where all meals were served, all business transacted, and where such amusements and pastimes as the age afforded were indulged in. At *i* is the keep, or *donjon*, entirely surrounded by a water-filled ditch and in front by the curtain wall *j*; and at *t* is its entrance over a drawbridge similar to those at *u*. The keep was the most important structure of the entire castle, being the final place of refuge in time of siege, and the last point of defense, when all other towers have been surrendered. At the Castle of Coucy this keep was 108 feet in diameter and its walls were 34 feet in thickness at the base. Its height of over 180 feet was divided into three stories, each of which was a vaulted hall or chamber with twelve ribs, or *groins*, converging to an opening or eye in the center. The uppermost of these chambers was by far the largest, as the walls were not so thick as at the base, and around the inside was built a broad gallery, 10 feet above the floor. In this immense apartment fifteen hundred soldiers could be assembled, and an officer standing in the center could give his orders, which were heard by every man. Around the outside of the keep, at the gallery level, supported on projecting corbels, was a parapet wall, the floor behind which was pierced between the supporting corbels with openings, through which the besieged could shoot or pour boiling oil, molten lead, etc. upon the besiegers below. These openings, called *machicolations*, were a characteristic detail of the towers of every feudal residence.

Down in the basement of this massive structure were not only storerooms sufficient for provisions to last a thousand men over a year, but also dungeons for the confinement of prisoners taken in war, who were in most instances left to starve in darkness and filth, without the shadow of a chance of ever seeing daylight again.

Back of the keep is a chapel *p* exclusively for the use of the liege lord and his family, but opening into the great hall *h*, which, as said before, was practically the only living room in the house. The family apartments contained but few sleeping rooms, and the noble and his family, with their servants, retainers, and visitors, were all accommodated in this one room, where all household and public duties were carried on. The smaller towers, *l*, *m*, *n*, and *o*, were built entirely for purposes of defense, and in time of peace were practically unused.

**92.** Having studied the details and arrangement of the residence of a medieval nobleman, let us now consider the system of government under which these people lived, that we may better comprehend the gradual evolution of society from the darkness of the middle ages, and discover from whence many of the forms and devices of modern house planning are derived.

These castles were usually located on the top of a hill, with the ground sloping away from all sides but one, and on this one side was the principal entrance. On the lower slopes of the hill was the town, or cité, as it was called, where the vassals of the nobleman grew their vines and plied their trades; but they held their various pieces of land subject to the rule and under the tenure or lease of the lord of the castle. They were compelled to pay him a large portion of their produce, and to serve him in the defense of his castle at any time he should be at war with any of his neighbors. The lord, in his turn, held his estate, or *fief*, subject to some higher political power, as a duke, or even the king, and his failure to comply with the demands of his superior would usually bring down a war upon his shoulders and necessitate the calling of all of his vassals to the defense of the castle. These petty wars were very frequent, and generally ended in the almost total destruction of the castle, or in its entire subjugation, and the passing of the fief into the hands of the enemy.

In case the lord of the castle was successful and retained his estate, his vassals were then rewarded with silver or gold; but, in either case, they were compelled to give one day's work out of every five or seven towards the repair of the damaged castle walls. Each time this rebuilding became necessary, some more or less important change would be made in the construction, owing to experience gained at each war; consequently, the architecture of these castles was rapidly progressive, until the use of gunpowder in warfare rendered the castle system of defense practically useless. The castle was none the less the earliest form of nobleman's residence, and, therefore, the prototype of the modern mansion. Long after fortified residences became obsolete, the castellated form was used even for a city residence, and as late as the middle of the fifteenth century we see many prominent features of both plan and elevation that remind us of the days of the feudal system.

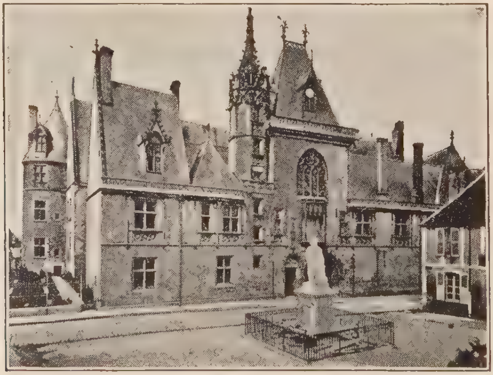

FIG. 86.

The house of Jacques Cœur, a wealthy French merchant, Fig. 86, was built about the year 1443, and we can readily see in its court the original idea of the inner bailey, while its towers and turrets are suggestive of the fortifications of less peaceful times. The interior, however, is decidedly different from the arrangement of the feudal castle, though it is the direct descendant of it.

Education of the people brought about a desire for privacy, and the great hall *h*, Fig. 84, was reduced in size by having a room cut off from it, where the sire and his family could retire after their meals had been eaten. This room was called the *withdrawing room*, and is the parent of our modern *drawing room* and *parlor*. The lord still received his guests and attended to his public affairs in the *hall*, however, but it was separate from the room where he took his meals, which now became known as the *dining hall*. In the fourteenth century, owing to the increased desire for privacy, the highest development of the hall was attained, and on the introduction of the withdrawing room, we see the germ of the modern gentleman's residence, which, in its highest development, is an expression of the wants, inclinations, and habits of the refined society of today, as was the keep and castle of the feudal society of the middle ages. The Gothic hall was planned with a vestibule separated from the hall itself by a heavy-paneled and carved-oak partition, or screen, as it was called. Over this was a minstrels' gallery, where musicians and vocalists played or sang for the entertainment of the family or guests, while at the farther end of the room was the *dais*, or raised platform, on which the master and his principal guests were seated. A large bay window fitted with seats gave external as well as internal emphasis to this end of the hall.

In the fifteenth century, the fireplace, instead of being placed in the center of the apartment, as it was in the earlier days, was removed to the side wall, and the sleeping apartments were much improved and increased in privacy; and in the sixteenth century the common dining hall decreased in importance, and the lord and his family dined separate from his servants.

The development of the house plan from this time forth was directly due to the advancement in the education of the people during the celebrated period called the Renaissance. Studying classics and classic forms, they learned to admire the ancient ornament, and applied it, at first, to the details of their Gothic castles and manor houses. As time progressed they applied not only the ancient ornament to their residences, but they imitated the plans and shapes of classic tombs and temples in the edifices which were intended as domestic structures.

## RENAISSANCE ARCHITECTURE.

### INTRODUCTION.

**93. Renaissance,** meaning literally rebirth, is the name applied to that period of European history when humanity emerged from the ignorance of the dark ages, to the light of reason and common sense. It is a period marked by education and enlightenment, as distinguished from the ages of superstitious ignorance which preceded. Previous to this time few persons could either read or write, even among the nobility, such accomplishments being confined almost entirely to the clergy. But about the middle of the fifteenth century, a desire for learning spread among the people, and the study of classic literature brought to light, not only the knowledge of classic forms and customs, but also the superior education of the upper classes of the people during the advancement of imperial Rome. The fifteenth century students, then, naturally inferred that the designs executed by such a literary and artistic people as the Romans, must necessarily be far superior to anything of which their contemporaneous architects were capable, and a sudden revolt from Gothic to classic forms took place throughout the Continent; and attempts at imitation of classic buildings were immediately started, regardless of the purpose or place, or the convenience of the construction to the later requirements of buildings.

The Renaissance architect knew nothing of the history of architecture leading up to these classic forms — knew nothing of the structural necessities which lay at the origin of the architectural orders in Greece, nor of the structural differences and lack of appreciative taste which caused the modification of those orders in Rome; but he accepted the classic designs as beautiful, simply because classic literature so declared them, and the people who wrote that literature must in his estimation have been well enough educated to know. With this blind misconception of facts, the Renaissance architect proceeded to enclose his Gothic plan with four walls, whose elevations showed an abundance of classic detail of the true meaning of which the designer was entirely ignorant.

Heretofore, in both classic and Gothic architecture, all ornament on a building had been a part of the structural system; a column, an entablature, or a pediment had existed in its original design because the construction required its services; but now, the architect adopted these details and planted them on and in his building to support imaginary constructions which the edifice itself in no way required.

The architectural principle, therefore, was at first manifestly incorrect, but, notwithstanding this fact, Renaissance designs were many of them very beautiful in appearance, and displayed great ingenuity in the fitting of the classic forms to their new places; but the history of architecture, as a historical development of constructive principles, ceased with the advent of this style.

**94.** Renaissance architecture naturally originated in Italy, where the classic monuments were most numerous; from there it spread to France, and finally reached England. Its progress in each of these countries was inversely as the progress of Gothic had been. In Italy, where Gothic had never secured an unrestricted development, the Renaissance was adopted and developed without any apparent opposition. It first appeared in the early part of the fifteenth century, and reached the zenith of its development before the close of the century. In France it did not appear until the close of the fifteenth century, and was first combined with Gothic details; it progressed steadily to the beginning of the seventeenth century, but then began to decline. In England, the Renaissance secured no foothold until the middle of the sixteenth century, and its progress and development was slow, as the country had been so thoroughly imbued with Gothic taste that the new forms met with but little favor.

The political condition of Europe at this time had a marked influence upon the architecture, as well as had the changes which were taking place in the Christian church. New nations had been formed and civilized since the days of classic Rome, and consequently the royal palaces and villas of the nobility formed a new class of building upon which the architects could lavish the classic details. The Christian church had become split, one part adhering to the old forms and traditions, and the other part insisting upon reforms, both of the government and the doctrines of the church.

Church building therefore received a setback, as the unity and power of the great organization which had made the Gothic cathedrals possible, was now temporarily broken, and all classes of people became more worldly in their tastes and less devoted to their religious duties.

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### ITALIAN RENAISSANCE.

**95.** The architects of the Renaissance occupied themselves more with form than with construction, and their buildings show but few problems in construction involving any great difficulty. Although the new style began with the construction of a colossal dome over the cathedral of Florence, and culminated in the stupendous Church of St. Peter at Rome, it was preeminently an architecture of palaces, of villas, of facades, and of decorative display, rather than of ecclesiastical works.

**96.** The Duomo, Fig. 87, was the cathedral of Florence, Italy, and though erected during the Gothic period, it was not finished until the year 1464, when the lantern was completed. The dome proper, covering an immense octagon 143 feet in diameter, was finished by Brunelleschi about 1444.

This work, started in 1420, was the first use of the dome as an external feature, outside of the districts of Byzantine art, and though in itself it was not an imitation of Roman forms, it was classic in spirit by its vastness and its simplicity of outline, and was made possible only through Brunelleschi's studies of Roman design and construction.

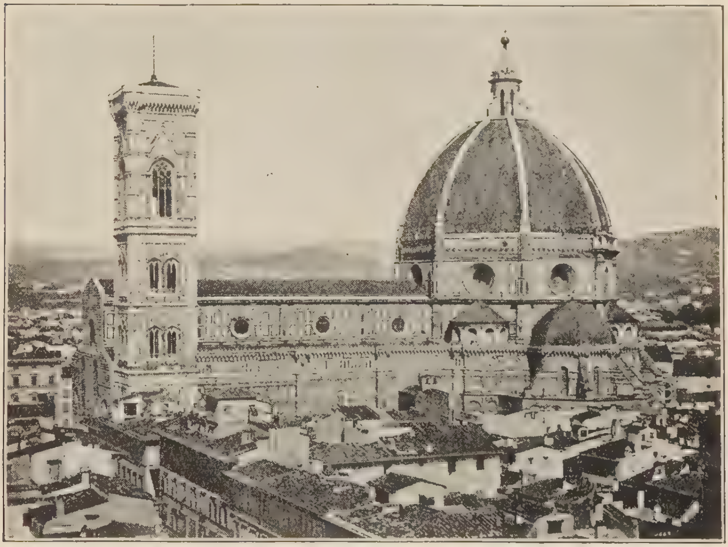

FIG. 87.

**97.** The Riccardi Palace in Florence, completed in the year 1430, was the first residence erected in the Renaissance style. It is an imposing structure with a rectangular facade, two stories in height, standing over a massive basement, and crowned with a classic cornice of excessive proportions. The windows were mullioned as in the Gothic style, but were widely spaced with intervening piers of rusticated ashlar masonry. The general exterior appearance of these palaces is somewhat fortress-like and forbidding, but they were nearly always built around an interior courtyard, which was light and cheerful, and which was surrounded by a vaulted colonnade on three and sometimes on four sides. The origin of these interior courts may be found in the atrium of the early basilicas in Rome, where precisely the same arrangement existed in front of the entrances. They afforded shady open-air resting places within the palaces, and added much to the comforts of the buildings as residences, besides materially enhancing their architectural effect.

The Pitti Palace, Fig. 88, designed by Brunelleschi, embodies the same ideas upon a much larger scale, but lacks the grace of an adequate cornice. Here the wall surface is broken by heavy rusticated pilasters in two stories, while the windows on the garden wings are small and unobtrusive. The windows on the court, however, are exceedingly wide, occupying, with their flanking columns and pilasters, the full space between the rusticated orders.

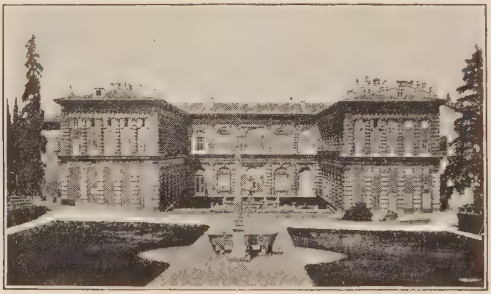

FIG. 88.

**98.** In Fig. 89 is shown a view of the Strozzi Palace, erected in 1490, which may be taken as a typical example of the Florentine style of Renaissance design. The first story, it will be observed, has small windows protected by heavy iron gratings, while in the center of the facade is a broad entrance door, which was guarded by a heavy iron gate. This fortress-like arrangement is due to the fact that these palaces were in part castle and part residence. During the frequent local wars of this period, it was often necessary for the nobility to retire within their palaces and defend them against the attack of an invading army. The exterior was therefore made very formidable, not only in appearance, but also in fact, while the upper stories of the interior and the elevations on the court present an appearance much more in accordance with the idea of domestic life and household comforts. The broad entrance door in the center of the facade was a carriage entrance, or driveway, into the court, and from this court, under the shade of the surrounding arcade, several doorways gave access to different parts of the palace. The upper stories of the building, though executed in the same style of heavy rustic ashlar, were provided with more liberal arched window openings, which were divided by a central columnar mullion and two smaller arches extending from the mullion to the jamb on each side. The space between the tops of the smaller openings, and the soffit of the arch over the main opening, was sometimes pierced by a simple system of plate tracery, as in the Gothic designs, but as the style advanced this and other details of Gothic origin were abandoned, and the style approached nearer and nearer to the old classic system of design. The heavy cornice crowning the building is designed with modillions or consoles, as in the Roman-Corinthian order, and is proportioned to the height of the building, in the same ratio as though

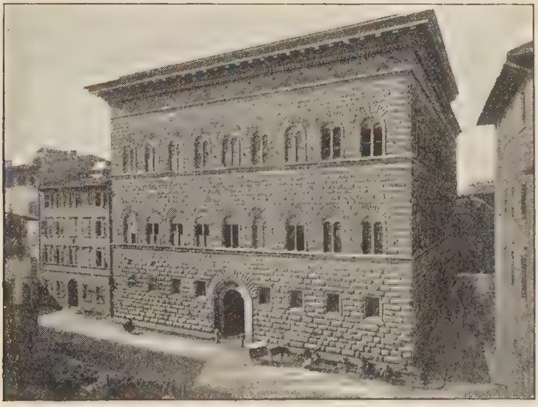

FIG. 89.

the entire substructure was a Corinthian column and pedestal.

**99.** The Florentine school, or system, of Renaissance design, is expressive of formidable dignity and structural severity on the exterior, but displays the most delicate appreciation of refinement and luxury in the treatment of the court elevations, and the arrangement of the interior plan. Large rooms, high ceilings, and broad unbroken wall surfaces, richly decorated with frescoes and arabesque designs, are characteristic in all the Italian schools of Renaissance design, but in Florence particularly this interior treatment is to be seen at its best, on account of the omission of columns and pilasters, as the principle feature of interior decoration.

**100.** The effect of the Renaissance movement upon the architecture of Venice was manifestly different from the Florentine style, owing largely to the geographical differences between the two cities. Venice being more distant from Roman influence, and having possessed a certain amount of Gothic influence, was ready to treat the Roman forms with more freedom and delicacy, while Florence, situated in the center of the ancient district of Etruscan art, naturally inherited some of the tendency to heavy and massive construction.

In the Venetian school of the Renaissance, columns and pilasters are used freely in all designs, the windows are grouped near the center, leaving comparatively solid boundaries to the facade. The facades are flat, having no great projections, in consequence of the buildings being situated along the sides of canals, instead of on streets and therefore necessitating a straight front on the water. The rustication of the walls seen in the Florentine school is comparatively unknown in Venice, and the facades usually have a separate cornice marking the division between each two stories instead of the heavy cornice crowning the whole structure, as at Florence. Balconies are numerous and the details of the facade are regularly disposed and symmetrically grouped.

**101.** The Vendramini Palace, Fig. 90, was built in 1481, and is one of the earliest buildings in Italy where engaged columns are used to divide the facade. The lines of its composition are vigorous and stately, and its broad arched and mullioned windows, separated by engaged columns, established a type of large windowed and vigorously modeled facades, which later architecture developed but never surpassed. The treatment of the arched heads of the windows is suggestive of Gothic influence, though the mullions and other columns are derived directly from Roman models. The grouping of the windows towards the center of the building, and leaving a flanking wall mass on each side is a typical Venetian feature which is also traceable in some of the Gothic designs, as shown in Fig. 83.

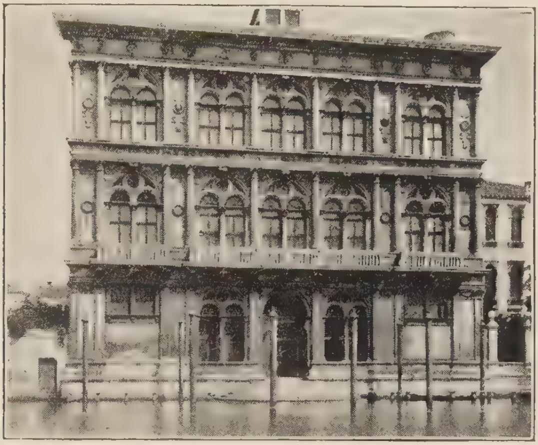

FIG. 90.

**102.** Among the architects conspicuous in the Venetian school of Renaissance, were San Micheli and Andrea Palladio, the former through his designs for such works as military fortifications, city gates, etc.; though his palaces at Verona and Venice were also much admired, and are interesting as showing the wide difference of ideas conceived by two men contemporaneously studying the classic models and converting their details to modern uses. San Micheli adopted the Roman orders quite as readily as did Palladio, but he used them in only one story at a time, as shown by the front elevation of the Grimani Palace at Venice. Here each story of the building was treated as a separate composition, with independent columns, or pilasters, and a proportionate cornice. The openings were made very wide, and the well separated columns were thereby made to appear as though they really carried some of the superstructure and were needed in the building, while the cornice crowning the structure was proportioned to the height of the whole, and tended to unify the composition. Palladio's designs usually made use of the orders in gigantic proportions, reaching from the basement to the cornice of the structure in single shafts, between which the window openings were simple rectangular wall piercings.

**103.** The characteristics of the Venetian school are: elaborate exterior designs, in which the Roman orders are extensively used; wide openings and a tendency towards elaboration and detail, rather than towards structural simplicity and purely architectural effect.

**104.** As the Renaissance advanced, it was inevitable that the constant study of Roman architecture should lead to a closer imitation of classic details and eventually to an absolute copying of antique designs. Towards the close of the fifteenth century, correctness in the rendering of the ancient Roman forms came to be considered the chief of architectural virtues, and the *orders* became the principal resource of the architect. Externally the orders were freely used in the decoration of doors and windows, and in the court arcades of the palaces. Frames around these openings, and pediments over them were extremely elaborate, and cornices and moldings were profiled with the utmost care, while the balustrade was elaborated into a most intricate and ornate device, but always on strictly classic lines. This period started in Rome with the erection of St. Peter's Church and continued till a complete transformation was effected throughout the city.

**105.** Bramante, the first architect of St. Peter's, proposed to combine, in one design, the great dome over the Pantheon with the vaulting of the Temple of Peace, and thereby erect a building which should exceed in size, elaboration, and structural complexity, any ecclesiastical edifice ever erected. The foundation for this great church was laid by Pope Julius II, on the eighteenth day of April, 1506. Bramante died seven years later, but the building was continued at irregular intervals, under different architects until the year 1546, when Michael Angelo was assigned to the work by Pope Paul III. Michael Angelo completed the building with the exception of the dome, which was finished after his death in 1564, by Fontana. Michael Angelo left a plaster model of the dome from which it was completed according to his design. It is 140 feet in diameter and poised on the top of a circular colonnade; it rises to a height of 405 feet above the church floor. As left by Michael Angelo at the time of his death, St. Peter's Church was as harmonious a design as existed in the Renaissance style, but in 1606 the nave was lengthened, under orders of Pope Paul V, and the proportions were destroyed, as the dome became hidden on close approach, and the facade was tasteless and insignificant. The magnificent *atrium*, surrounded by the double colonnade, which was added by Bernini, in 1667, gives dignity to the approach, but does not compensate for the weakness of the design of the main facade, Fig. 91.

St. Peter's is the largest church in existence. The central aisle, nearly 600 feet long and 83 feet wide, with its splendid paneled and gilded vault, together with the central space under the majestic dome, combines to form an architectural conception unsurpassed in majesty, simplicity, and effectiveness. This interior, Fig. 92, is, however, lacking in the sobriety of color that is befitting so stately a design. Elaborate carvings, brilliant frescoes, and expanses of burnished gold, are more suggestive of the interior of a pagan temple than of a Christian basilica, but reveal the decline in taste towards the end of this great period, of a style which, borne on a tidal wave of popularity, swept over Europe and exhausted

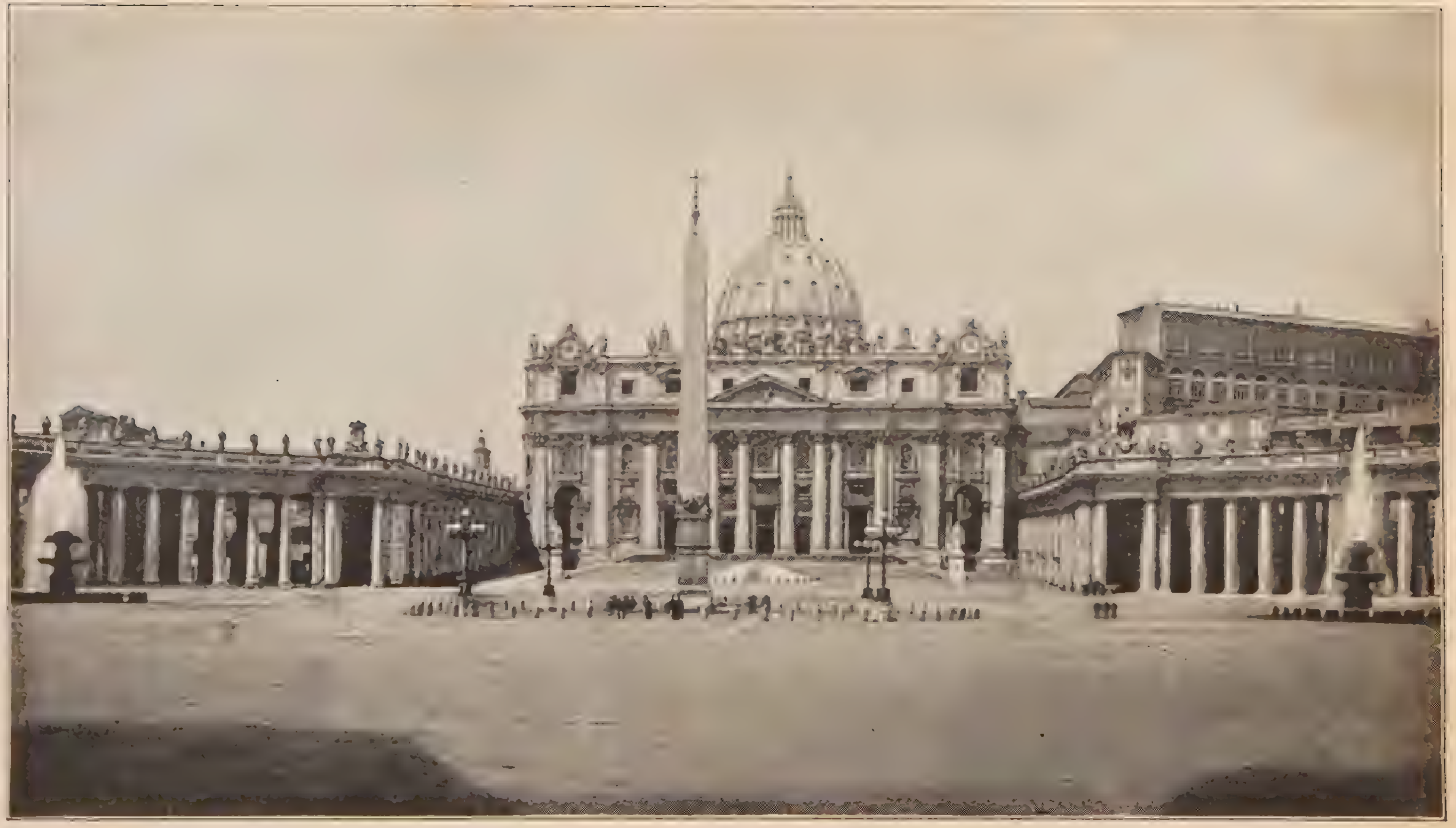

FIG. 91.

itself in the effort to constantly approach a false ideal. At the advent of the Renaissance the architects were compelled to exercise much ingenuity, in order to combine the classic and Gothic forms, but with advanced study their ingenuity declined and the practice of a servile copying of classic forms resulted.

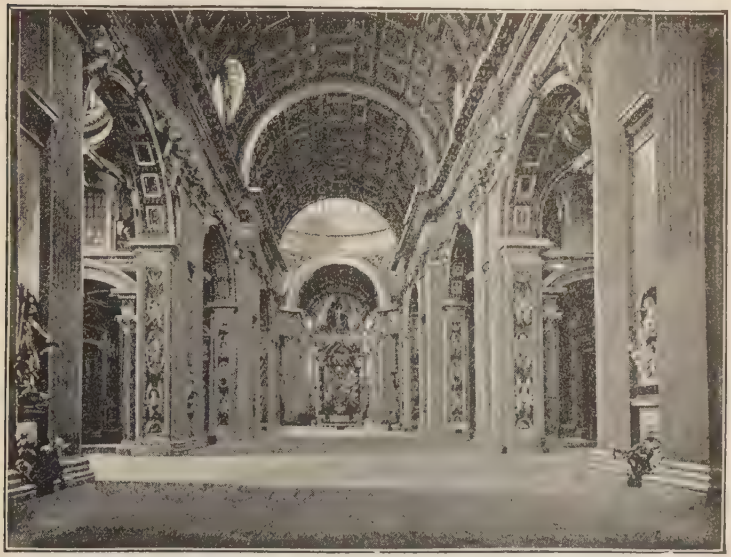

FIG. 92.

St. Peter's Church is noble in its proportions, majestic in its conception, and gorgeous in its decorations, but at the same time its coloring is gaudy, its design is servile, and its style inappropriate as a monument to the Christian faith.

**106.** The Church of St. John Lateran, in Rome by Galilei, erected in 1734, Fig. 93, shows on its exterior the application of the orders in excessive proportions, as first practised by Palladio at Vicenza. The design is a very powerful one, however, combining, as it does, a colossal order with two smaller orders in superposed loggias. The composition is marred by the excessive size of the statues which crown it, but, taken all together, this facade may be considered as one of the masterpieces of the later Renaissance. The portico is 33 feet deep and 196 feet long, and the open loggia above it is one of the finest in Rome. In this portico we have the legacy of one of the chief characteristics of the earliest Christian churches; namely, the *narthex*. During the transition from the Romanesque to the Gothic period, the narthex disappeared from most church plans entirely; but in Rome the churches of St. Peter, St. Paul, and St. John Lateran (originally built during the reign of Constantine) adhered very closely to their early plans in spite of the numerous changes and alterations which succeeding periods imposed.

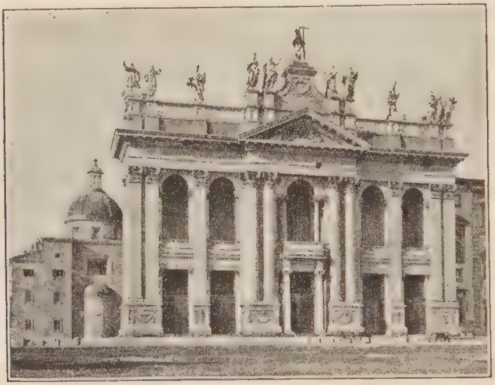

FIG. 93.

**107.** The palaces of Rome are classed among the finest in Europe. Their design is not as heavy as those of Florence, nor as delicate as those of Venice, but the architects of the Roman Renaissance period have, by means of a diligent study of the ancient monuments, reproduced in the palatial residences of their aristocrats the most imposing features of the tombs and temples of their pagan ancestors. Roman palaces were usually of great size and built around large courts, with arcades of classic model in two or three stories. On the street front, the structures were crowned with a rich cornice proportioned to the height of the building, in the relation of entablature and column. The orders themselves were used but rarely on the exterior, and effect was obtained by careful proportioning of the stories, and in the form and distribution of the openings. The first story was given up to suites of sumptuous apartments, elaborate halls, reception rooms, etc., the walls and ceilings of which were decorated with magnificent frescoes by the greatest painters of the day, and groups of statuary and bas-reliefs were disposed in the courts and vestibules, and in the wall niches of the principal rooms of these princely dwellings.

**108.** The finest of the palaces, the Farnese, built by Sangallo in 1530, is shown in Fig. 94. It is an immense building, 260 feet by 192 feet, whose rectangular plan and simple elevations are given dignity and impressiveness by the careful proportioning and arrangement of the window openings, and by the treatment of their details. The lower story is very plain, consisting merely of a row of square-

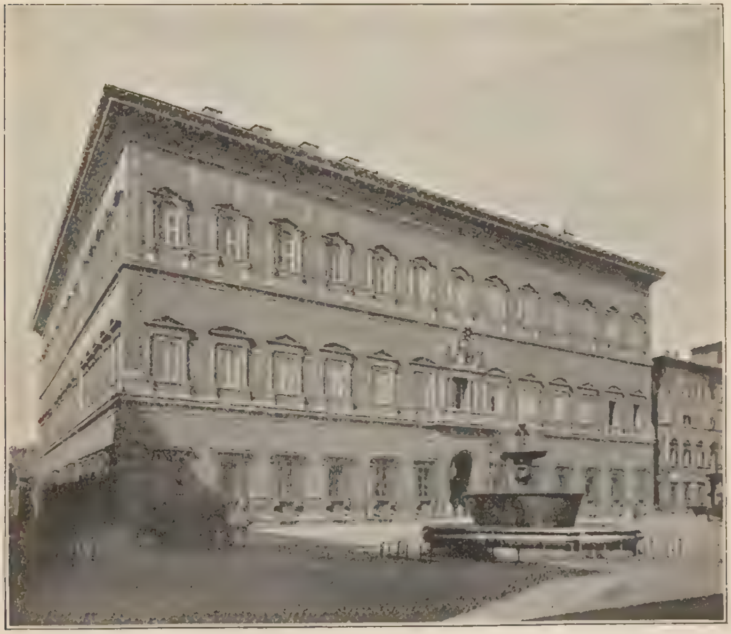

FIG. 94

headed openings in a plain masonry wall surface, which is relieved at the center by an immense carriage entrance to the beautiful court within. The windows in the upper stories are flanked each side by three-quarter columns, which support a pediment over each opening, and the whole structure is surmounted with a magnificent cornice, designed by Michael Angelo, which is worthy of its position on the finest palace in Rome.

The interior court of the Farnese palace is a magnificent enclosure over 125 feet square, and surrounded on four sides by a deep colonnade, over which the second story of the palace extends. Like all the Renaissance palaces, the court elevations of the Farnese are considerably more elaborate than the exterior fronts, but the simple treatment of the entire design places it in the lead as one of the most successful buildings in the Renaissance style.

In Fig. 95 is shown the court of the Borghese Palace, which is typical of this detail of Renaissance design. The arcades rest upon clustered granite columns, of the Doric and Ionic orders, in the first and second stories respectively, and the whole is proportioned with much delicacy and refinement.

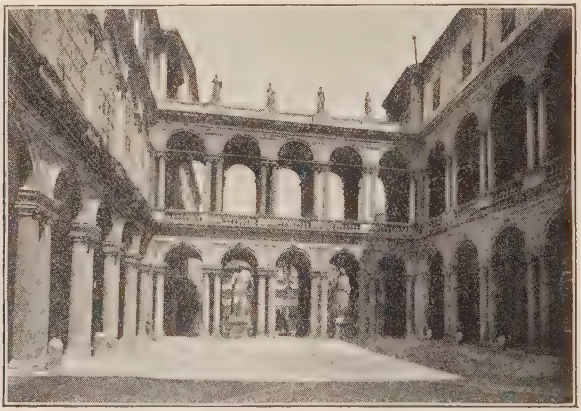

FIG. 95.

**109.** When these palaces were built on the outskirts of the city, or beyond the municipal limits entirely, the courts were sometimes dispensed with, and great care was given to the laying out of a park or garden on one side of the palace, which should afford a pleasing outlook from the principal rooms.

In Fig. 96 is shown the garden front of the Villa Medici, erected in 1540 by Lippi. The entrance, with its central arched and flanking trabeated openings, and supporting columns, is a typical detail of the Roman school of the Renaissance, which was much copied in many subsequent buildings erected in other countries. The walls of this facade are tastefully decorated with numerous bas-reliefs of allegorical subjects, and are indented with niches for the reception of statues and busts. The window openings are few and comparatively small as they face the southwest, and the rays of the tropical sun are not desired within. This lack of windows is the cause of the surface decoration of the walls proper and the consequent originality of the design.

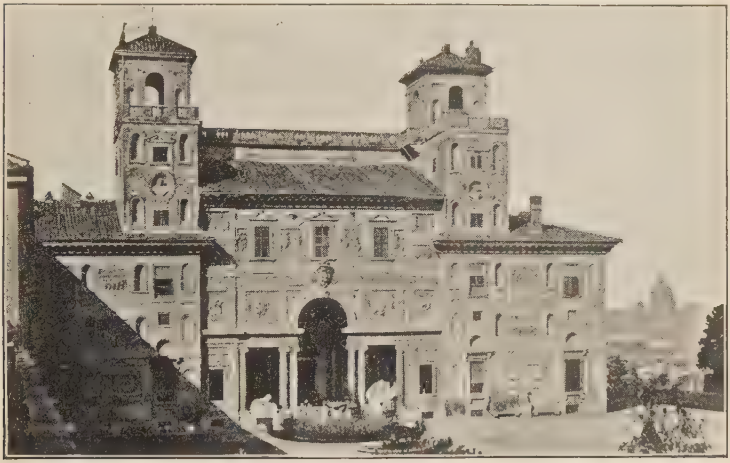

FIG. 96.

**110.** Two architects prominent in the Italian school of Renaissance, were Giacomo Barozzi de Vignola, who built many of the finest palaces in Rome, and Andrea Palladio, whose works in and around Venice have already been alluded to. These men each wrote a treatise on the "Five Orders of Architecture," which was accepted by the contemporary and subsequent architects as a standard of authority. Vignola's book is particularly exhaustive on the subject, and goes into the minutest details relative to the proper proportions which should exist between different members of an order in a building, or between the members of two different orders, and is used as a standard of reference even at the present day.

### FRENCH RENAISSANCE.

**111.** Renaissance architecture in France was at first greatly influenced by the declining Gothic art. The French artisans, who for years had been carving Gothic ornaments and details, could not change their style of working so completely that the classic designs were not somewhat tainted with Gothic feeling, and as the architects themselves were trying to combine a classic ornamentation and a Gothic construction, the resulting edifices in the early French Renaissance exhibit an individuality possessed by no other class of buildings in Europe.

This early Renaissance was marked by the free and liberal use of the architectural orders, and is consequently much more artistic than the later work. That is, the Roman orders were altered to suit a Gothic construction (and well fitted their places when so altered), instead of the system which prevailed later in the style of making the plan, construction, and even convenience of the buildings entirely subservient to the prolific use of classic details and combinations. Gothic architecture had always made use of small columns in places where the load to be supported was small, and in consequence the Renaissance buildings first erected in France have the small details characteristic of the preceding style—widely different from the works of Palladio in Italy, where the orders were used in gigantic proportions, to ornament a meaningless and false construction. In France, the high-pointed gables and the numerous pinnacles of the old style were retained after the advent of the Renaissance, thereby presenting a new field for classic detail never before known. Castles which had existed in previous years only in the Gothic style, now assumed a new aspect exceedingly beautiful and decidedly novel from an architectural standpoint. The plans were very similar to the old buildings, as at this time there had not been sufficient change in the general condition of society to induce an alteration of the plans of the residential buildings.

This early period of the French Renaissance is generally termed the Francis I period, and it lasted from 1483 to 1559; after which the Gothic feeling became entirely superseded, and the architecture became a servile imitation of the classic designs according to the proportions established by Vignola. This is called the Henry IV period, and lasted until 1610. The age of Louis XIV, which followed this, was typical of great exaggeration in the details of the orders and the ornaments applied to the buildings. In the effort to invent an improved style while they were still tied to the Italian school, there resulted only the introduction of a meaningless lot of ornamental forms and grotesquely designed capitals which are characteristically described as *rococo*, a French term meaning frivolous.

**112.** The most interesting monuments of the French Renaissance are the châteaux. These constituted the country residences of the kings and their royal relatives. The chateaux are somewhat similar in character to the villas of Italy, but were situated farther away from the cities, and were used more as *rural* retreats than were the Italian villas. A characteristic that distinguishes the French from the Italian Renaissance, as explained in Art. **90,** was that the earliest royal residences were in the form of a feudal castle; and when the invention of gunpowder rendered the castellar system of defense ineffectual, these residences began to assume a less forbidding appearance and a more hospitable outlook.

Large mullioned windows, flanked by classic pilasters, pierced the outer walls, while conical and high-peaked roofs covered the towers and main buildings. Richly ornamented dormer-windows and pilastered chimneys broke the roof slopes, while the buttresses and vaulting of the Gothic system were still retained. Thus we find the honest straightforward system of castellar construction emerging from its crudeness, and bedecking itself with the refinements and frivolities of the approaching Renaissance. Along the River Loire are a number of these châteaux, many of which were erected or altered during the reign of Louis XII, while others were remodeled by his successor, Francis I. The châteaux along the Loire Valley therefore afford the student most excellent monuments from which to study the French Renaissance throughout its entire development.

**113.** The Château of St. Agil, shown in Fig. 97, still possesses, each side of the drawbridge entrance, the massive towers of feudal days, and the spreading foundations where its walls sloped off to the defending moat. Somber-looking, stone-bound loopholes, still exist in the sides of the original brick towers; but, on the front, overlooking the approach, these relics of feudalism have been replaced by liberal window openings, flanked with paneled pilasters, and divided by molded mullions and transomed bars. The stone buttresses each side of the doorway, originally built to receive the thrust of the vault, have outlived their structural usefulness, and are now deeply niched on the angles to receive a piece of statuary. The parapet walls are roofed over, the machicolations are closed up, and though the supporting corbels still exist, they are richly molded now to form a part of the cornice work under the upper construction of the building. Through the slopes of the roof appear richly carved dormers, whose flanking pilasters on the towers are carried down to the corbel course, while through the parapet wall over the entrance a broad mullioned window expresses the fact that comfort and hospitality within have replaced the barbarous scheming which took place there a century back. In short, the stern feudal castle of the dark ages has matured in the picturesque château of the Renaissance.

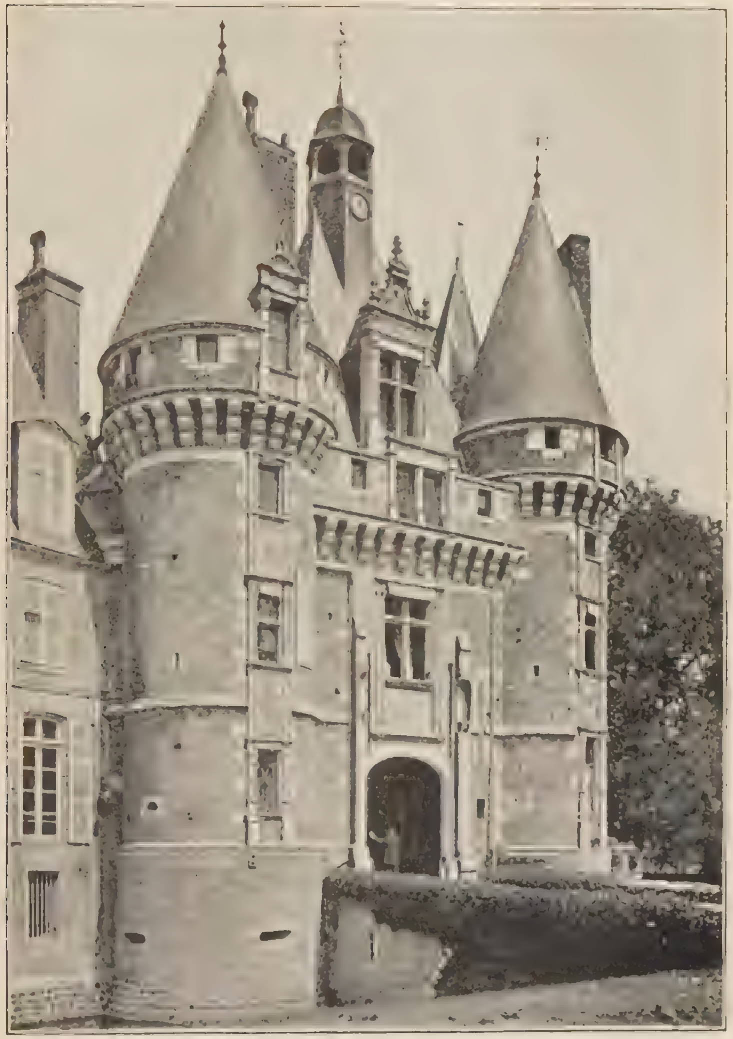

Fig. 97.

**114.** Though long before the beginning of the reign of Francis I, the feudal system had disappeared from France, yet the architecture of the day adhered to the details which were characteristic of the feudal castle. The Château Azay-le-Rideau, Fig. 98, though erected in the sixteenth century, still retains the corner turrets and the corbel parapet of its feudal ancestor; but what a change of details—windows whose breadth nearly equals their height; gabled dormers which are masterpieces of the sculptor's skill; paneled chimneys as ornate as the pilaster-flanked doors and windows, and with all this extravagance of detail, contrasted with broad surfaces of absolutely plain wall to prevent monotony.

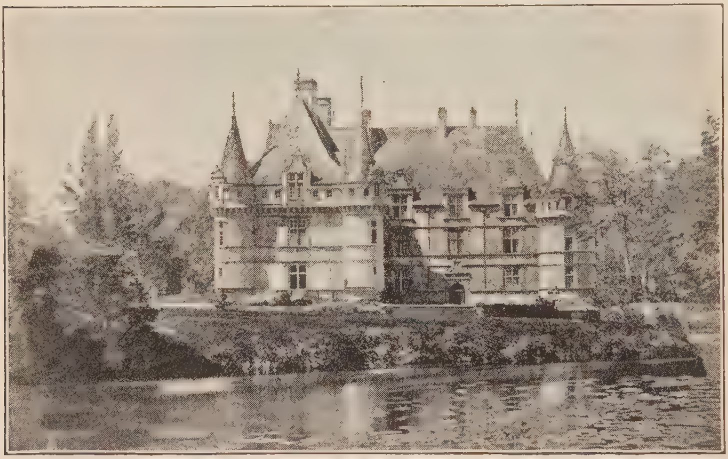

FIG. 98.

Nothing could be more graceful than these sixteenth-century châteaux; they combine the structural dignity of the Gothic with the taste and refinement of the Renaissance period, without expressing either one to excess. Every detail of Azay-le-Rideau betokens the refinement of aristocratic taste, while its plan and system of construction are in no way hampered in order that the details may be expressed. As the Renaissance became more advanced, the value of these points was overlooked, and the structural principles and ornamental details became separate and distinct considerations, the latter often serving the purpose of hiding the character of the former, thereby really expressing an architectural untruth.

**115.** The Château Chenonceau, though built about the same time as Azay-le-Rideau, is expressive of a more advanced period of the Renaissance than is the latter. On the north front, shown in Fig. 99, the towers will be observed flanking the facade, but of much smaller diameter than their feudal prototypes. The flanking bartizans, which in feudal ages guarded the central entrance, are now replaced with two corbeled balconies supported on pilasters. The dormers are large and richly ornate, the center one being designed to include two attic stories in order to emphasize its increase in size. The corbel course and parapet wall have here entirely disappeared, though across the eave line a light cornice is carried upon a row of small consoles, over a paneled frieze, which reaches down to the window heads. The openings in the towers are comparatively small, and possess no ornamental features whatever, the towers themselves having shrunken to the grade of a mere detail of the design,

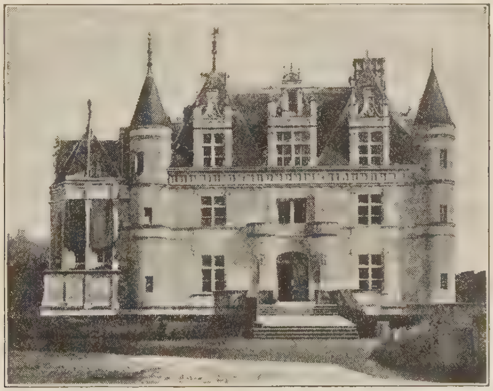

FIG. 99.

whereas in former periods they were the main adjuncts of the castle. This, however, shows an advancement in design. When towers and turrets were most essential features to the defense of the castle, they were also the most prominent parts of its exterior design; but now, when they no longer play an important part in the welfare of the structure, they are retained only as a relic of the past, and retired to make room for the display of windows and balconies, which are more characteristic of the advanced period.

**116.** The largest, and in some respects the most important, of these country residences of royalty, is the Château de Blois, a plan of which is shown in Fig. 100. In this structure, as it exists at the present day, are brought together the expressions characteristic of each successive period of the French Renaissance.

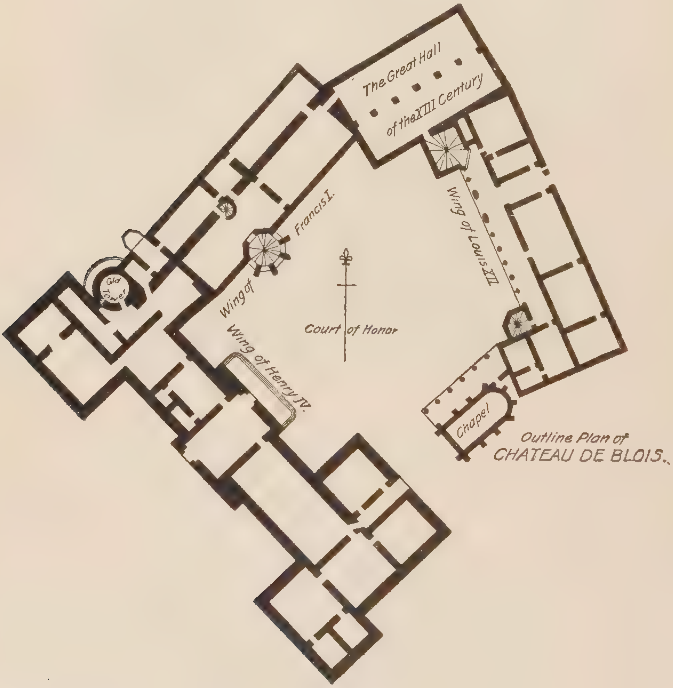

FIG. 100.

The plan of the château consists of three wings so disposed as to enclose a *court of honor* in the form of a distorted quadrangle, this irregularity being a most conspicuous and characteristic bequest, left to the new structure by the old medieval castle on whose lines the present edifice is erected.

The northeast side was built by Louis XII at the end of the fifteenth century; the northwest side was completed by Francis I in the middle of the sixteenth century; and the southwest side is the work of Gaston of Orleans in the beginning of the seventeenth century. The wing of Louis XII, shown in Fig. 101, is built of black and red brick combined with light stone. Its roof is high, of purple slate, with

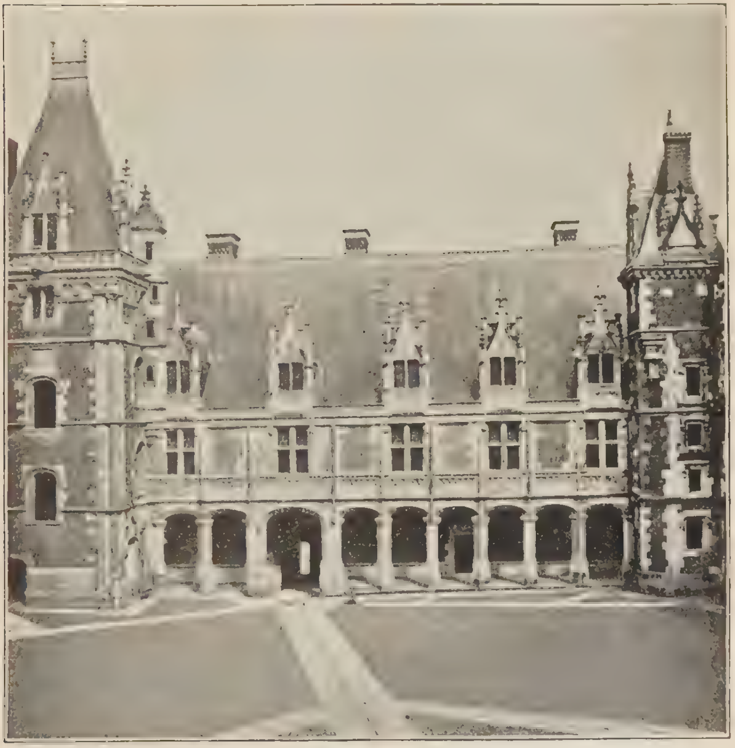

FIG. 101.

beautifully studied dormers, the details of which are more suggestive of Gothic than classic models, as are also the moldings of the windows below. But the open portico in the first story, with its flat, three-centered arches, supported on alternate round and square shafts, all richly decorated, are characteristic of the new school of design, and make, with the five great mullioned windows above, a regular and well disciplined design. The archway which leads through the wing to the exterior of the château is emphasized by being somewhat wider than the others, and flanked by heavier piers. On the outside, this entrance to the court of honor is flanked by rich engaged shafts under a conventional Gothic niche, wherein, against an elaborate background of fleur de lis, rides King Louis XII upon his charger, Fig. 102. To the right of the entrance, a little sally port gives the pedestrian access to the passage, over which, in bas-relief, is carved a porcupine and knotted cord, which, with the conventional fleur de lis, is emblematic of Louis XII and Anne of Austria, his queen.

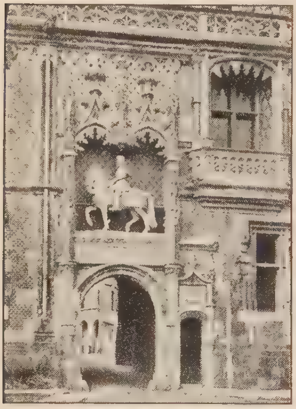
FIG. 102.

**117.** We will now turn to the wing of Francis I, on the northwest side of the court, Fig. 103. This was erected but fifty years after the wing of Louis XII was completed, but the difference in style is manifest even to the most casual observer. The artists of the sixteenth century, hurried along by the swift current of those fifty years of wonderful intellectual regeneration, seemed to understand even better than their successors that the Romans had not used the orders as elements of construction, as the Greeks did, but as decorative details having no essential relation to the construction whatever. They seemed to know by instinct that there was no law, moral or artistic, why they should not take those Roman orders and details, and use them in any way they chose, structural or nonstructural, so long as their use

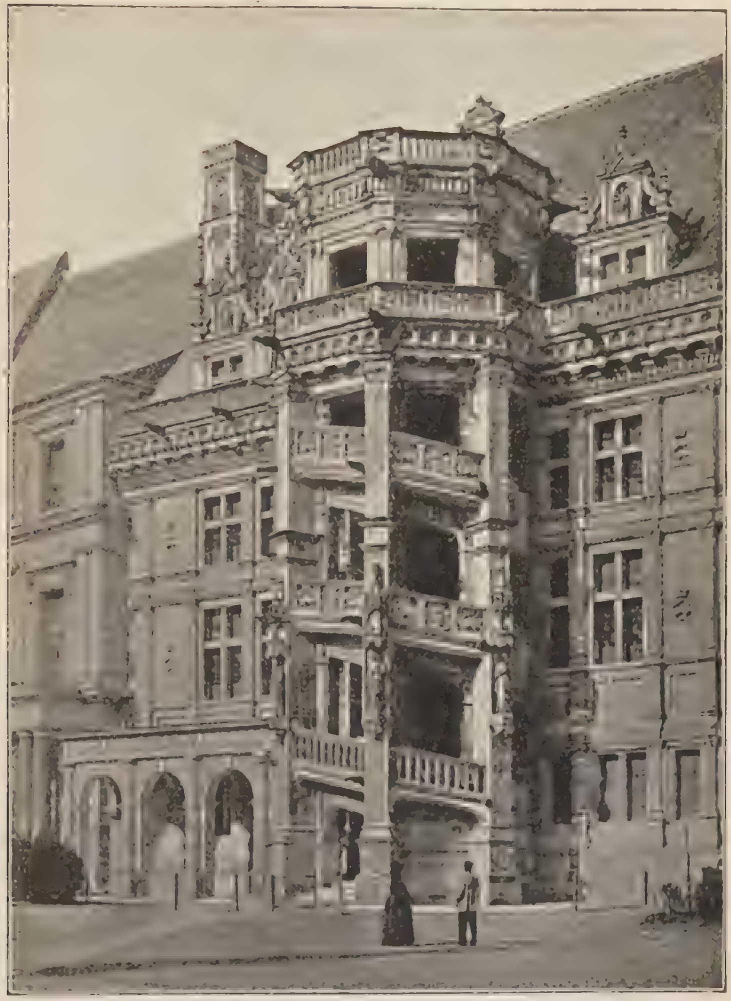

FIG. 103.

suited the purpose to which they were applied. Thus, a study of this period of architecture shows that the French builders accepted not the conventional restrictions of the classic formulas, but their essential spirit as an organized scheme of ornament.

The court facade at Blois shows that the lessons in classic styles given by the great Italian masters, who were entertained at the court like princes, were accepted by the French architects with respect and intelligence, but were not learned by rote. The lessons were accepted as an influence, but not as a law. The windows in the basement have but little vertical coincidence with those of the stories above, showing an irregularity of fenestration most certainly due to Gothic influences. The flanking pilasters of these basement windows support a string-course, which forms a line of demarcation between the inferior order and that of the more important system of pilasters, which, while they decorate the two stories above, have no direct relation to the scheme of division beneath. At the eave line, the old Gothic cornice of defense is converted into a cornice of most delicate beauty. The coarse corbels which supported the parapet are replaced by elegant modillions, borrowed from the Corinthian order, and the black machicolations between them, through which ancient defenders of the castle poured missiles and boiling oil, became a series of delicately molded arches, the soffits of which each enshrined a shell. Below this cornice a row of dentils and minor moldings suggested a study of the classic orders, while above it an elaborate balustrade was carved with the crowned letters F and C, for Francis and Claude, the king and queen.

**118.** The greatest artistic effort of this facade, however, was the octagonal staircase, which is considered one of the masterpieces of the sixteenth century, though it is at the same time another example of the audacious independence of the French architects of this period. It has no architectural relation to the wall surface from which it protrudes, except that its four great free-standing buttresses support a cornice and balustrade, which are a continuation of those on the wall. These supporting buttresses, whose axial lines in plan radiate from a common central point, are divided into two sections by horizontal moldings, marking the level of the third-story floor, while they stand on molded bases, and are topped with carved capitals of a composite character. A niche on the lower part of the face of each of these piers, contains a beautifully carved female figure under a canopy of most elaborate fancies of Gothic imagination, expressed in the terms of the new period of art. With these features the horizontal elements of the stair tower cease; every other detail ramps with the ascent of the stairs. Richly carved balconies on these sloping lines are carried from pier to pier, the balustrades being divided into panels, each alternate one of which has carved in high relief the crowned F, or the crowned Salamander, both emblematic of Francis I. The design of all these features is free and romantic, yet when we compare this wing with the neighboring one built but fifty years before by Louis XII, we cannot but consider them new and fresh, articulate and grammatical expressions of Renaissance feeling, with none of the timidity which generally characterizes the first trial of a new style.

**119.** In the southwest wing, Fig. 104, which was designed by François Mansart, for Gaston of Orleans, a brother of Henry IV, we see the tendency of the age not to adapt the classic detail to the construction, but to literally copy the classic orders, and to decorate every opening and angle with some form of classic ornament, regardless of the convenience of plan, or propriety of the detail. As the architects became more learned they lost their fearlessness and independence, and instead of simply borrowing ideas from classic models, they appropriated the whole design. The Roman orders of architecture, according to Vignola, were loyally reproduced by Mansart in the southwest wing at Blois, presenting a contrast to the wing of Francis I that is full of historic meaning.

Mansart constructed the first story in the Doric order, the second story in the Ionic order, and the third story in the Corinthian order, precisely as the works of Vignola dictated. The window heads, pediments, and arch imposts were all intended to be strictly Roman, and a suggestion that any part of the composition was of French origin, would have been considered an insult to the designer. The roof, however, was an invention of the architect; existing through necessity, but designed to slope back, as if hiding

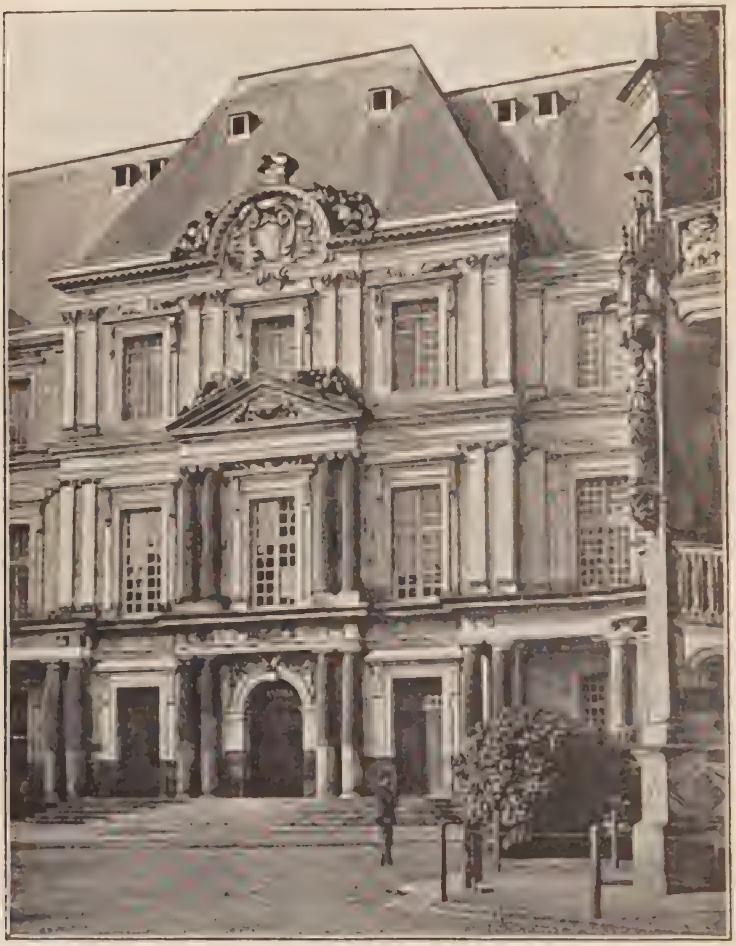

FIG. 104.

itself behind the aristocratic classic detail. No high roofs existed in the ancient monuments, and it was impossible for the architects of the seventeenth century to introduce to prominence any detail, no matter how necessary, that had not its origin in classic Rome.

**120.** The most important work of the Francis I period, was rebuilding the Palais Louvre, in Paris. The old Gothic fortified palace had always been the principal residence of the kings, but it had become so unsuited to the requirements of the age, that it was torn down in 1546 and entirely rebuilt in the new style, from plans prepared by two architects—Serlio, an Italian, and Pierre Lescot, a Frenchman. The Louvre consists of a quadrangular court 394 feet square, surrounded on four sides by galleries, two of which extend westward till they meet the Palais Tuileries. The east wing, or gallery, of the Louvre is 548 feet long and 90 feet high, and contains the celebrated colonnade, subsequently designed by Perrault. The south side faces the river Seine, and is 2,250 feet long. In the middle of each facade facing the quadrangular court, there is a pavilion rising above an archway over each of which are constructed niches, which were afterwards embellished with statues. The height is divided into three stories, the divisions of which are emphasized by pilasters in the Corinthian and Composite orders. The orders, however, were not used in great prominence, and the ornament and sculpture were appropriate and refined.

**121.** The transition from the style of Francis I to the period of Henry IV, is marked by a tendency of the designs towards the characteristics of the late Italian school. The orders are now used very conspicuously, and pilasters assume extravagant proportions, as in some of Palladio's designs in Italy, while rustication in most fantastic forms disfigures the columns and archivolts. Fig. 105 shows one of the entrances of the Palais Louvre, the detail of which is typical of this period. The elaborate rustication of the columns, the carved griffins, etc. in the frieze and the crowned

H on the panels over the columns are all details which combine to stamp the design as a composition of the advanced Renaissance, when the trend of the style was towards absolute classic servilism.

The southwest wing, at Blois, belongs essentially to this period; Gaston of Orleans, its projector, having been a brother of Henry IV. There can be little doubt that the strides towards classicism at this time were hastened by the marriage of the king Henry IV to Marie de Médicis, an Italian who introduced into the French court a taste for Italian art, literature, and customs.

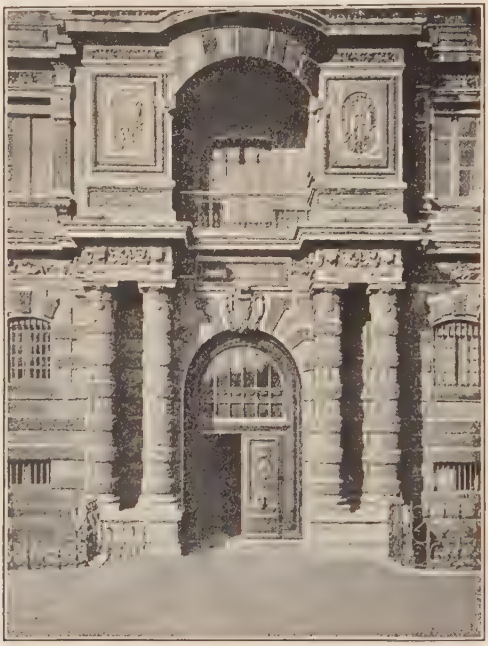

FIG. 105.

**122.** The **Age of Louis XIV** was remarkable for its literary and artistic activity. The architecture was conspicuous by its liberal use of the orders in exterior design, while the interior decoration was light and capricious, usually to excess. Papier maché and stucco were freely used in a fanciful style of relief ornamentation, far better suited to the decoration of a boudoir than to that of a ballroom, or hall of assembly.

In 1688 the east wing of the Louvre was completed from the designs of Claude Perrault, the court physician, whose plans were accepted in preference to those of Bernini, the celebrated architect of St. Peter's colonnade at Rome. His design consisted of a magnificent Corinthian colonnade nearly 600 feet long, standing upon a high basement of the simplest construction, Fig. 106. This colonnade forms one of the most imposing facades in existence, but is at the same time a mere decoration, and possesses no structural relation to the building it forms a part of. It is dignified and stately and well suited to its position on the facade of the finest palace in France, but its existence is structurally as unnecessary as the papier-maché ornament on the interior walls.

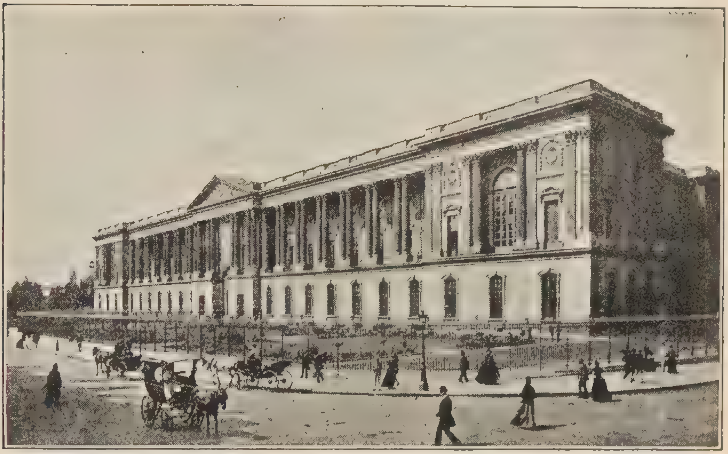

FIG. 106.

To this period is also due the Hôtel des Invalides, or veterans' asylum, Fig. 107, by J. H. Mansart, a son of François Mansart. Here we see the classic orders in superposed series with Palladian regularity, while the whole is crowned with a dome, which is a masterpiece of the age.

**123.** French Renaissance architecture is marked by the good proportions of its parts, and the harmony and propriety of its detail. The most interesting period is undoubtedly that of Francis I, so far as studied exterior design is concerned, but throughout its history the French Renaissance steadily advanced in the mastery of planning, and its use of pavilions, crowned by high-peaked or Mansart roofs, gave even in classic designs an individuality found in no other

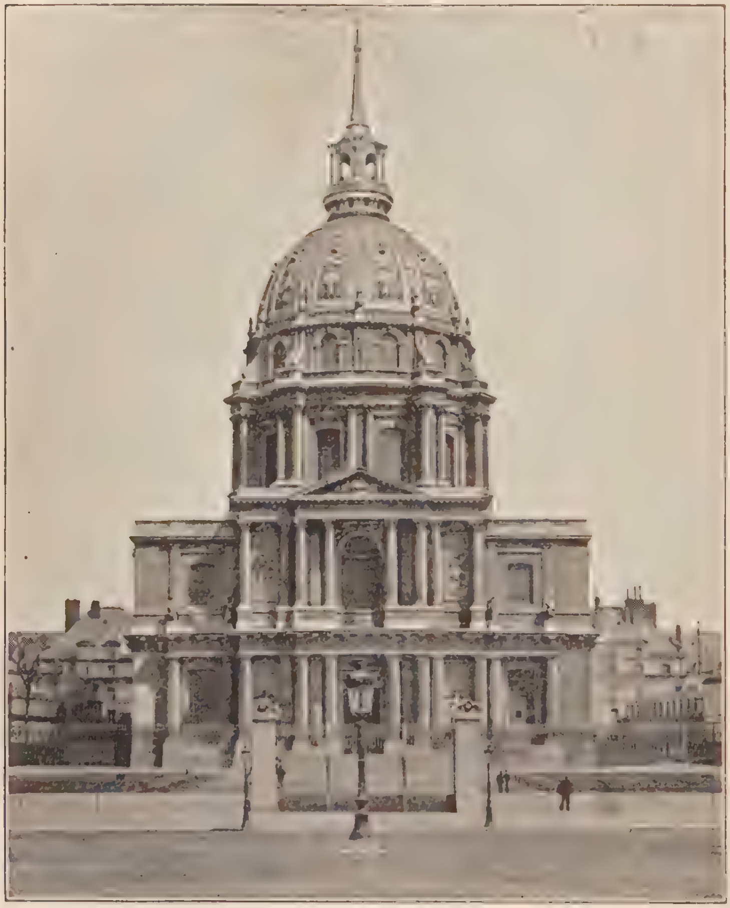

FIG. 107.

country. French Renaissance is essentially an architecture of staircases, dormers, chimneys, and roofs, as well as of monumental disposition of plans—the latter being an element in which the French excel even down to the present day.

**124.** Let us now sum up the characteristics of the French and Italian Renaissance, comparing one with the other. In Italy, there was a direct return to classic forms, while in France there existed a period of transition where classic details were grafted on Gothic construction.

In Italy the principal buildings were erected in the cities, while in France the country châteaux formed the most numerous examples. In Italy, the narrow streets of Rome and Florence, and the straight waterways of Venice, made severe classic disposition not only appropriate, but necessary, while in France, the picturesque disposition of Gothic origin was more in keeping with the country surroundings. In Italy, the influence of ancient Rome is apparent in the purity of the classic detail, while, owing to her distance and Gothic association, France was late in duplicating the Roman forms, and even then copied them from the Italian Renaissance duplications.

A street front in the Italian cities being usually seen only from one side, the architectural features are often planted on without reference to what is on the other side, whereas in France, a château being seen on all sides, a picturesque grouping from every point must be carefully studied.

Thus we see that though the same conditions brought about the change of style in France as in Italy, the local and geographical differences caused a different line of progress in the two countries.

### SPANISH RENAISSANCE.

**125.** Spanish Renaissance architecture was contaminated with details of Moorish origin on the south, and influences of the French flamboyant Gothic on the north. The style was not developed independently in any part of the country, and the monuments left us at the present day have been so frequently altered, that the original details in many cases are obscured or lost.

It should be borne in mind that it was at the beginning of this period that America was discovered and explored by Spain. The long wars against the Moors had also ended with success on the side of the Spanish arms, and, puffed with pride in the importance of her extended possessions, Spain lavished in her architecture a conglomeration of detail, more elaborate than artistic.

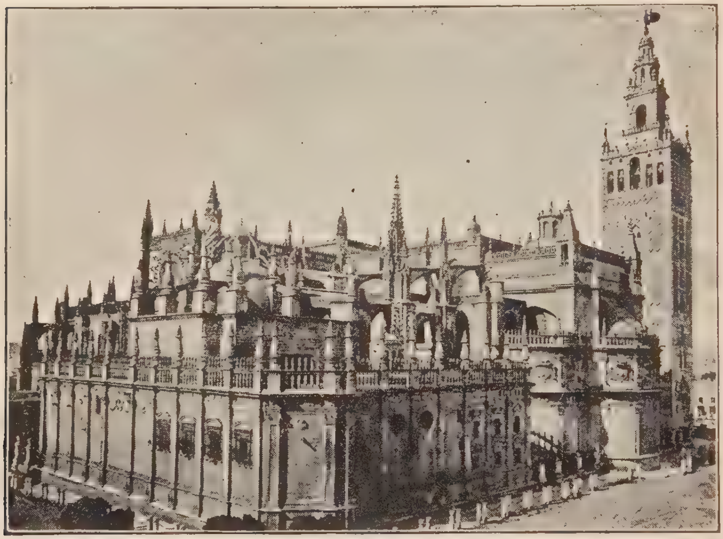

Fig. 108.

The Cathedral at Seville was altered at this time, and, as shown in Fig. 108, the classic pilasters and superposed balustrade are attached to an originally Gothic composition, the flamboyant spires and buttresses of which stand out incongruously behind the classic facade. The upper part of the adjoining Moorish tower of the Giralda, burned in 1395, was then rebuilt in the new style, and exhibits considerable elegance and propriety of design. The decoration of the wall surfaces with intricately carved diaper work is a characteristic of the Spanish style, borrowed from the mosques of her Moorish neighbors; while the vertical tendency of the lines and elaboration of crockets is a relic of Gothic days, inherited from the flamboyant period of France.

### GERMAN RENAISSANCE.

**126.** The Renaissance style in Germany is chiefly remarkable for its picturesqueness of grouping, and its

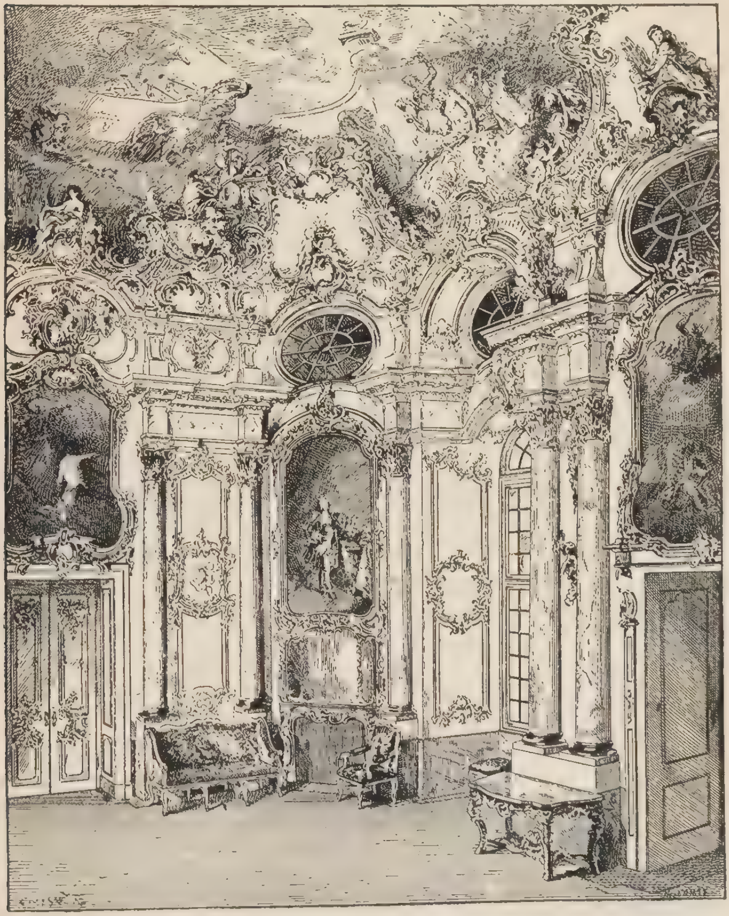

FIG. 109.

extravagance and grotesqueness of ornament, both of which characteristics are traceable to the traditions of the preceding style. Renaissance architecture was introduced into Germany from France, about the middle of the sixteenth century, when the Henry IV style was in force; hence the appearance of the early German Renaissance is marked by a coarseness of detail and crudeness of style, that grew worse as the style advanced. French architecture of the period of Henry IV was intended to be an adoption of classic models, but it fell short of its ideal, and when the German architect endeavored to reproduce a classic idea, with its French transcription as his model, the result could be none other than a mixture of style absolutely devoid of character. Moreover, the principal examples are found in the cities with details copied from French châteaux, and the effort was so unsuccessful that, with the advent of the Classic Revival period, Germany was most prominent in the complete abandonment of her Renaissance experiments.

In some of her Renaissance designs, Germany produced very gorgeous and elaborate effects, even if she did not produce anything of great artistic merit.

The rococo ornament of the period of Louis XIV and XV was received into Germany and carried to even greater excess than in France. Fig. 109 is a view of one corner of the state drawing room in the Palace Brucksal at Baden, and shows to what extremes this frivolous detail can be carried when the decorator is unfettered by lack of either money or talented artists.

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## RENAISSANCE IN BELGIUM AND HOLLAND.

**127.** These fantastic and grotesque extremes of the German rococo naturally influenced the development of the Renaissance in Holland and Belgium, though these countries were extremely slow in accepting the principles of Renaissance art. Long after the beginning of the sixteenth century, the Flemish architects continued to employ the florid Gothic for both religious and secular structures; and, as at this time Holland was a Spanish province, there is a strong suggestion of Moorish oddities intermingled with crude German rococo ornament.

The Church du Béguinage, Fig. 110, at Brussels, is a typical example of the Flemish style. The absence of building stone in this locality made brick construction the prevailing practice, and the appearance of the long, untapering,

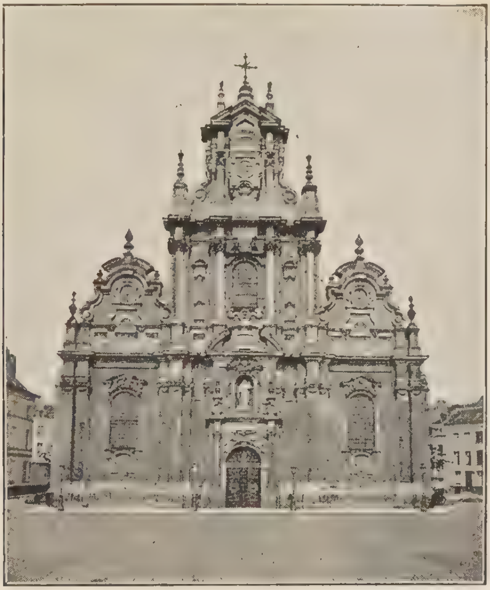

FIG. 110

Ionic, capped, brick pilasters on the facade of the Church du Béguinage, shows how ignorant the Flemish architects were of the origin and meaning of the forms they were copying. In the second story of the facade the semidetached composite columns are built up of brick, with a studied entasis, but are backed with pilasters, which the exigencies of the case required to be straight.

**128.** The treatment of the gables shows to what absurd extremes ornaments can be carried when not properly understood. The low pediment of Greek art was developed by

Gothic architects into the peaked gable to suit the climate of northern Europe; but here is a gable front which does not conform to the outline of the roof behind it, and which falsely declares itself to be the end of that roof. The scrolled outline of this gable, as well as the scheme of decoration around the door and windows, owe their existence to the perverted rococo of Germany; while the circular and elliptical windows are inventions of the later Renaissance in neighboring countries.

### ENGLISH RENAISSANCE.

**129.** Great Britain was the last of the European countries to formally adopt the Renaissance style. This was due to several reasons, but particularly to the firm hold the Gothic style had upon the country. Inigo Jones, the first classical architect in Great Britain, was not born when Giacomo Barozzi de Vignola, the most prominent architect of the late Renaissance in Italy, died in 1571. St. Peter's Church was started in Rome a full century before any classic structure in England, and the Palais Tuileries in Paris had been long inhabited before any attempt to rival it was made on the other side of the English Channel.

England was on very friendly terms with both Holland and France at this time, and this friendship had a very marked influence on the first attempts at classic architecture in Great Britain. The influence of Spain during the reign of Queen Mary is also very apparent for a time, but with the ascension of Elizabeth to the throne, the period of English Renaissance is fairly started and marked by the establishment of England as a Protestant country, and the defeat and decline of Spanish power in Europe.

**130.** The architecture of Elizabeth's reign was essentially a transition style, corresponding in circumstances to the period of Francis I in France, but far inferior to the latter from an artistic standpoint. Elizabethan buildings, like the châteaux of France, were erected most usually in the country, as the taste of the English nobleman was for a rural, rather than an urban, life; but many mansions were erected also in the cities, and the Elizabethan style became identified with residence construction throughout the country. This was due largely to the fact that, in the year 1536, Henry VIII suppressed the monasteries which had flourished since the eleventh century, and distributed vast sums of money, which they had accumulated, amongst his courtiers. Thus, nearly every nobleman in England became suddenly wealthy, and enabled to build for himself a house befitting his rank. A part of the funds from the suppressed monasteries was devoted to the erection of schools and colleges, so that this class of buildings, also, is intimately associated with the Elizabethan style of architecture.

**131.** Caius College at Cambridge was erected in the year 1574, and though the buildings were erected in the late Perpendicular Gothic style, the gates to the grounds were adorned with an abundance of classic detail, Fig. 111. Christ's College at London was founded at this time, though most of the buildings are of much more modern construction. The courtyard, shown in Fig. 112, is a fair example of the Elizabethan style of design. The square openings, with splayed jambs and molded drip-stones, point clearly to a Gothic origin, while the row of flattened arches and central gate are strongly suggestive of classic detail. The gable over the gate, typical of the Elizabethan period, undoubtedly had its origin in Holland, while the ornament in the center of the gable

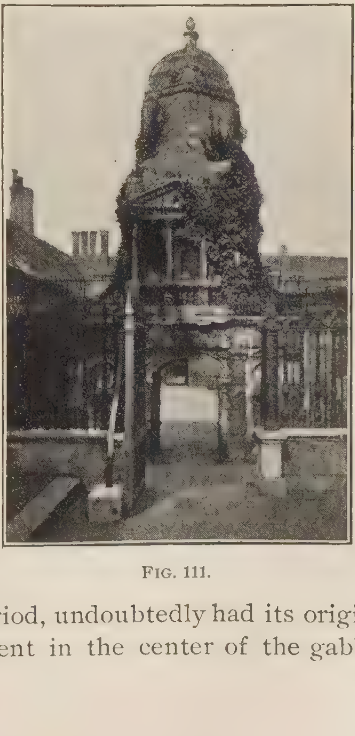

FIG. 111.

is strongly suggestive of the French rococo. The balustrade on top of the towers with its pierced panel work is another detail identified with the Elizabethan period, the origin of which is to be found in the later development of the Renaissance in other countries. Thus we see in the incipient stage of English Renaissance a sparing use of classic detail, of which the architects knew but little. They borrowed forms from other countries, but the character of their buildings was not lost so long as complete servilism to classic forms was avoided.

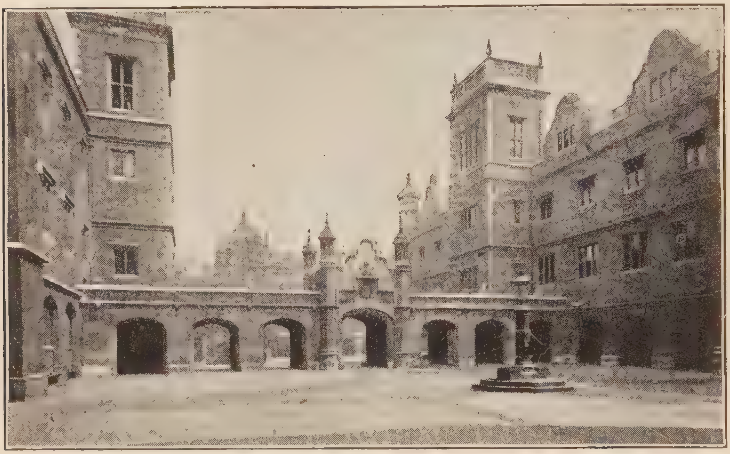

FIG. 112.

**132.** These borrowed forms were never original at the time of their adoption by the English architects. They had already been altered by the late Renaissance in France, corrupted by the brick designs of Germany, and elaborated under Spanish influence by the sixteenth-century Hollander. When the English architect began to study the classic forms more carefully, he lost his originality, and, like his predecessors in France and Italy, copied the Roman orders and designs with the exactness and precision laid down by Palladio. When James I ascended the throne of England, the detail of the Elizabethan period was carried to its greatest extreme. Everything was sacrificed to secure a startling and grotesque effect. The orders were used with a freedom that destroyed their character entirely. In many of the most important buildings, the columns were designed to be of greater diameter under the capital than at the base, to which they tapered without entasis. Pilasters were rarely designed with the smaller end under the capital, and were usually paneled and ornamented with an intricate plaited strap-work design in plaster. Grotesque figures of imaginary and human beings are carved as terminations of projecting brackets, hand rails, etc., and all idea of the grammar and propriety of ornament seemed to have been lost. This period lasted from 1603 to 1625, and the style, usually termed **Jacobean,** is the most inartistic in the history of English architecture.

**133.** The Elizabethan and Jacobean were nothing more than transitional styles from the Gothic to the Anglo-classic, and ceased to be practised as soon as the true Renaissance was introduced into England by Inigo Jones and Sir Christopher Wren.

Inigo Jones prepared himself by a long course of study in Italy with no less a person as his master than the great Palladio himself. In 1612 he revisited Italy to complete his studies, and on his return introduced into England a purer Renaissance style, founded upon the teachings of Palladio. The most important buildings designed by Jones were the Chilman Castle, Kent, in the transitional style (as though the architect felt somewhat timid in launching a pure classic design upon an inexperienced public); the palace at Whitehall, of which the Banquet House only was finished; and the Church of St. Paul, Covent Garden, an imposing little structure in the Tuscan order.

**134.** The greatest of Jones's successors was Sir Christopher Wren, the architect of St. Paul's Cathedral, London. Though he lacked the thorough technical education of his predecessor, Sir Christopher was a master of the art of construction, having studied his profession in France during the rebuilding of the Louvre, and thereby trained himself in the French system of construction, which was then unsurpassed in any part of Europe.

His French education caused his designs to show the influence of that country more than the works of Jones did, whose compositions were purely Italian. Palladio's writings continued, however, to be the inspiring influences of English design, as Vignola's had been of the French; but Wren's compositions possessed much detail that showed its French origin and materially influenced the work.

**135.** St. Paul's Cathedral, the principal of his works, was 480 feet long, with a transept across the center of its plan 250 feet in length, and a rotunda at the crossing, 108 feet in diameter. The style was strictly Italian, but lacking in variety and inspiration. The exterior is designed in two stories, Fig. 113, the upper one being a mere screen to hide the buttresses and clerestory, as shown in Fig. 114, which is a transverse section across the nave—a deception which illustrates the impracticability of the classic decoration on

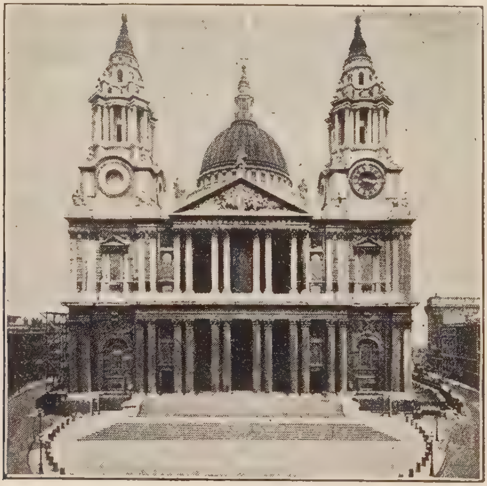

FIG. 113.

the Gothic construction. If the buttresses had been permitted to show on the exterior, they would have been incongruous with the classic detail; and, on the other hand, had the roof been constructed according to the Roman methods, the building would have been ill suited to the purposes of a Christian church. The most important feature of the design is the dome over the rotunda. This detail is also an architectural deception practised to heighten the effect of the design on the exterior. If the dome were hemispherical and poised directly over the vault of the nave, as in the Byzantine churches, it would have added dignity to the interior without being at all visible on the exterior. Had it been designed to suit the exigencies of the exterior design, it would have appeared strangely lofty and out of place from within. Therefore, in order to reconcile these two conditions, Sir Christopher built a dome over the rotunda to secure the desired interior effect, as shown at *a*, Fig. 115; around the circumference, and independent of this dome, he constructed a conical brick roof *b*, on top of which is supported the stone lantern, and around the sides of which a wooden dome, *c* is built entirely for exterior effect. This exterior dome, rising from a high drum surrounded by a peristyle of Corinthian columns, gives to the design an expression of dignity and majesty which would otherwise be entirely lacking; while the campaniles, or bell towers, and the two-story porch on the west

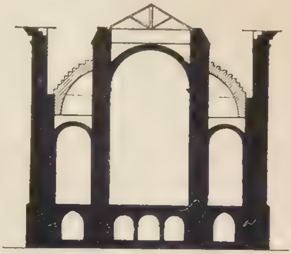

FIG. 114.

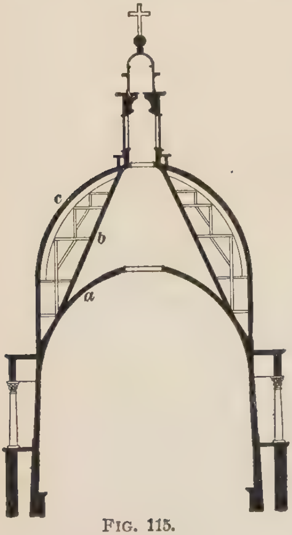

FIG. 115.

front, combine in an admirable composition, second only to the dome itself.

**136.** Besides the churches which he built, Wren was called upon to design more royal palaces than any other architect, before or since his day, but he did not in this field meet with the success that crowned the majority of his ecclesiastical designs.

The palace at Winchester was little more than a big brick barrack, to which purpose it has since most appropriately been applied. He was more successful with Hampton Court, though the design shows a want of proper study. The architectural orders are plastered on simply as exterior ornaments, and the entire facade is tame and meaningless. Chelsea College is probably the poorest design bearing Wren's name ever erected, but he partly redeemed his fame in the one at Greenwich, though this is not up to his standard.

When Sir Christopher Wren died, in 1723, he was succeeded both in practice and position by Nicholas Hawksmoor and Sir John Vanbrugh. The former was a pupil of Wren's, and was employed to carry out a good deal of his work. He built St. George's, at Bloomsbury; St. Mary Woolnoth; and St. George's-in-the-East, three edifices which plainly show the unsettled state of men's minds at this period. The first was a direct reproduction of heathen forms, being designed in part to realize Pliny's description of the mausoleum at Halicarnassus. The second was a design in which a strong effect was obtained by bold rustication and massive forms. The third, St. George's-in-the-East, is designed to get its effect entirely from its bold and massive character and detail, every trace of classic detail being omitted; the result, however, is a failure.

**137.** The works of Sir John Vanbrugh are all expressive of his one aim and desire; viz., to express in design a feeling of grandeur and eternity. Had his efforts been devoted to mausoleums and monumental structures, he might have made much more of a success. But as his productions were almost entirely palaces and villas, his energy was pushed in the wrong direction. Blenheim Palace, Castle Howard, Seaton-Delaval, and Grimsthorpe all bear the stamp of his ambition.

Blenheim was to Sir John what St. Paul's was to Wren —the opportunity of his lifetime, by which he would be judged and with which his name would be handed down to posterity. To build a monumental palace in a noble park on such a scale, and to be backed by the nation's purse, was in reality a greater opportunity than Wren had before him when he built a metropolitan cathedral, hampered by liturgical difficulties and jealous criticisms.

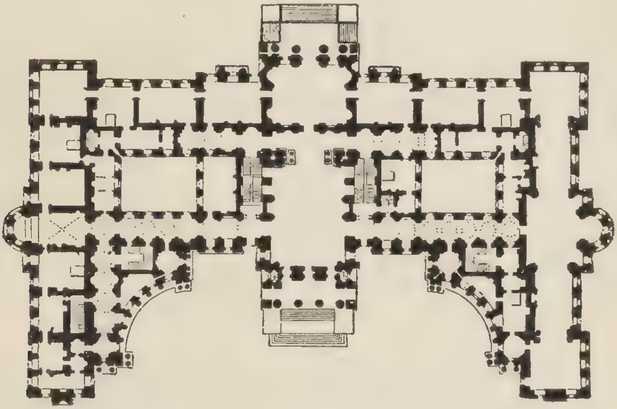

FIG. 116.

Nothing can well be grander than Sir John's plan and general conception of Blenheim Castle, as shown in Fig. 116. The garden front, 323 feet in length, was flanked on one side by the private apartments, and on the other by a magnificent library 182 feet from front to rear. In designing the facade, he carefully avoided all the faults of Versailles, which was the typical palace of the day, as well as the tameness which was the feature of Winchester and Hampton Court.

Castle Howard, of which Fig. 117 is the elevation, was erected by him about the same time. It is similar in plan to

Blenheim, but much smaller, though his skilful treatment of the facade has made it appear much larger than it really is.

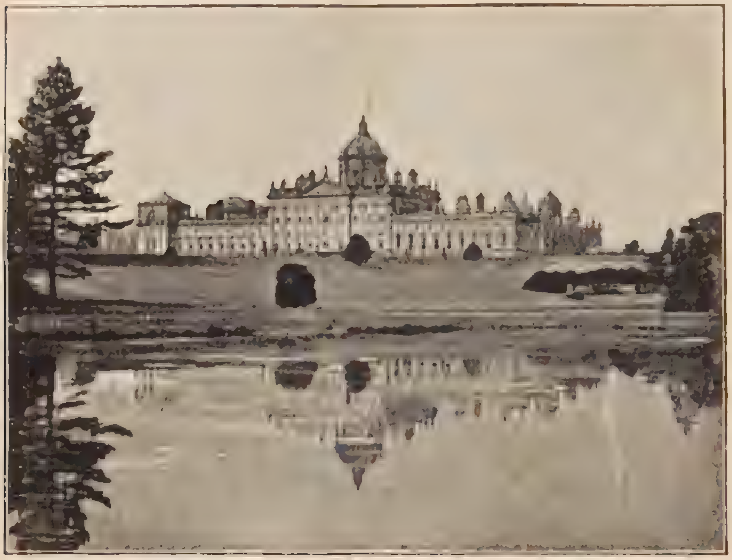

FIG. 117.

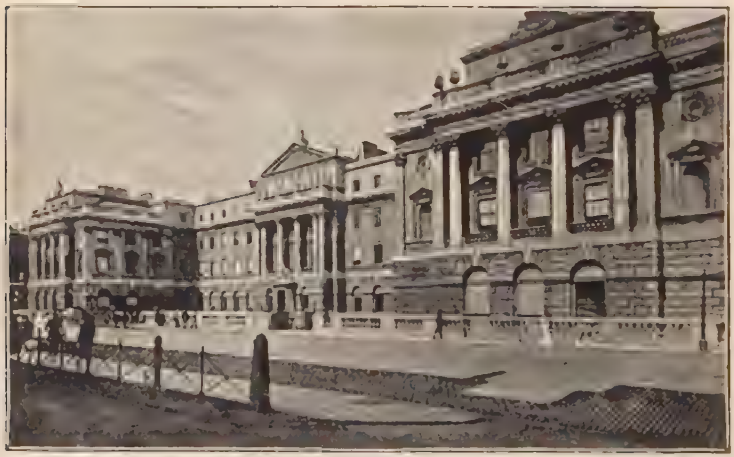

FIG. 118.

**138.** Somerset House, shown in Fig. 118, erected by Sir William Chambers towards the end of the eighteenth century, was a very successful design, though far beyond the ability of the architect. The bold rusticated basement supports a range of three-quarter Corinthian columns, and a well proportioned balustrade surmounts the whole in a pleasing and artistic manner.

## CLASSIC REVIVAL.

**139.** The essential difference between the architecture of the Renaissance and that of the Revival period may be thus defined. The former was the adoption of classic details to modern forms, while the latter required the complete subjugation of modern forms and necessities to accommodate the plan and arrangements of a pagan temple. Although classic details only were used in St. Peter's and St. Paul's, they could never be taken for anything but Christian churches. Whitehall and Versailles were the residences of the kings of the age in which they were built, and pretend to be nothing more. No one could think of St. Peter's as a Roman temple, and Versailles is as unlike the palace of the Cæsars as a building possibly could be, and so we find it throughout the three centuries during which Renaissance was practised. But, the Walhalla, at Ratisbon, pretends to be an exact reproduction of the Parthenon, and the Madeline, at Paris, is intended to be the counterpart of a Roman-Corinthian temple. St. George's Hall, Liverpool, is supposed to contain no feature later than the age of Augustus. Thus the early years of the present century were the beginning of a period of architectural slavery never before equaled. Architects no longer required originality, and he who possessed it was supposed to suppress it entirely, and reproduce some pagan building, line for line, fitting his purpose to the classic form, the best way he could, regardless of convenience, character, or tradition.

**140.** In Italy, there was, strictly speaking, no Classic Revival, as the Renaissance so thoroughly suited the tastes and requirements of the people that there was no demand for a change. In France, the frivolous designs and details of the period of Louis XIV had become tiresome, and the prosperity of the country had so increased that the public impression seemed to be that the Empire of France was to be the successor of the old Roman Empire. Severity and dignity of design, rather than delicacy and frivolity, was therefore demanded, and the duplication, line for line, of Roman temples was the method of its accomplishment.

In Germany, however, the Renaissance style had been such a failure, that the country was not inclined to adapt any more Roman forms, and an adoption of purely Greek designs was substituted; while in England, the influence of Palladio, during the Renaissance, was still sufficient to modify the style when Great Britain adopted the Greek Revival.

The effect of this revival in all countries was to increase the dignity and monumental effect of the streets at the expense of the convenience and practicability of the plans. Public squares and parks, surrounded by colonnaded buildings and deep porticos, were very fine to look at, but the porches and colonnades darkened the buildings and rendered them unfit for the purpose of their erection.

**141.** In France, the Classic Revival made its appearance during the reign of Louis XV, and the tendency towards it can be seen even before that. The Hôtel des Invalides, Fig. 107, erected during the reign of Louis XIV, shows nothing but the most servile imitation of Roman forms, but at the same time admits the necessity of windows, which are grouped to harmonize with the design. In the Pantheon, at Paris, however, we see a noble building, architecturally asserting itself to be a Roman temple, when, as a matter of truth, it is a Christian church dedicated to St. Genevieve, Fig. 119. In plan it is a Greek cross, 362 feet long and 267 feet wide, over the intersection of the arms of which rises a dome, 265 feet high and 69 feet in diameter. The whole exterior is a cold, severe, but extremely refined, composition. The elegant portico of colossal Corinthian columns, and the fine peristyle around the drum of the dome, combine to characterize the design as one of great dignity and effect. Its sides are plain wall surfaces, unbroken by window openings or carved ornaments, except the festoons along the frieze under the cornice. Light is admitted through the roof, the greatest care and ingenuity having been exercised to hide the fact that interior illumination of the edifice was necessary.

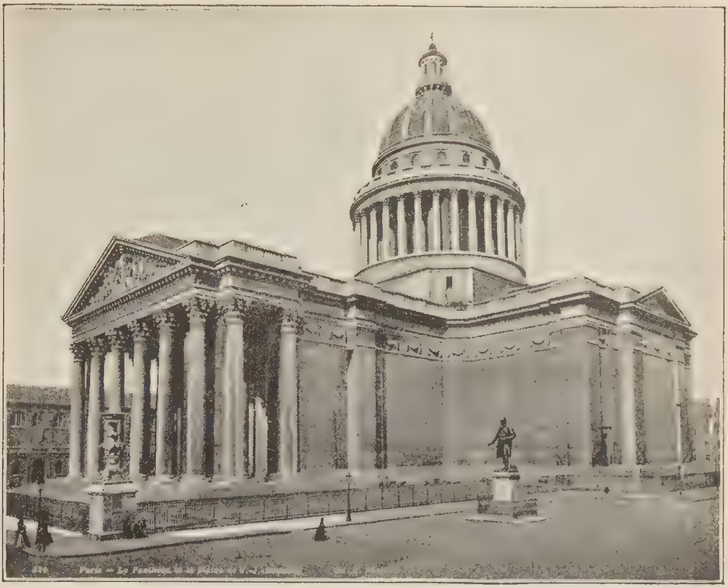

FIG. 119.

**142.** The Madeline, Fig. 120, is even more extreme in the effort to depict a purely pagan design than is the Pantheon. Here we have what appears to be a Roman-Corinthian peristylar temple, every line of which is carefully proportioned according to classic antecedents, though its purpose is to provide a place for Christian worship. Classic as this structure may appear in design, it is certainly not so in construction, each column being built up of small pieces of stone, the joints of which materially interfere with the effect of the fluting. The lintels, spanning the intercolumniations of the peristyle, are not single stone beams as in the temples of Rome and Greece, but are constructed of voussoirs like a flat arch. In ancient columnar architecture the spacing of the columns was governed by the length of lintel which could be conveniently quarried; hence, the intercolumniations were comparatively small. In the Madeline, the intercolumniations are still maintained according to the ancient standard, though, as shown by the voussoired lintel, there is no structural necessity for it. But the Parisians desired their city to be a second Rome, and in order to carry out the appearance, they confined their architectural designs to the duplication of Roman edifices of historical renown.

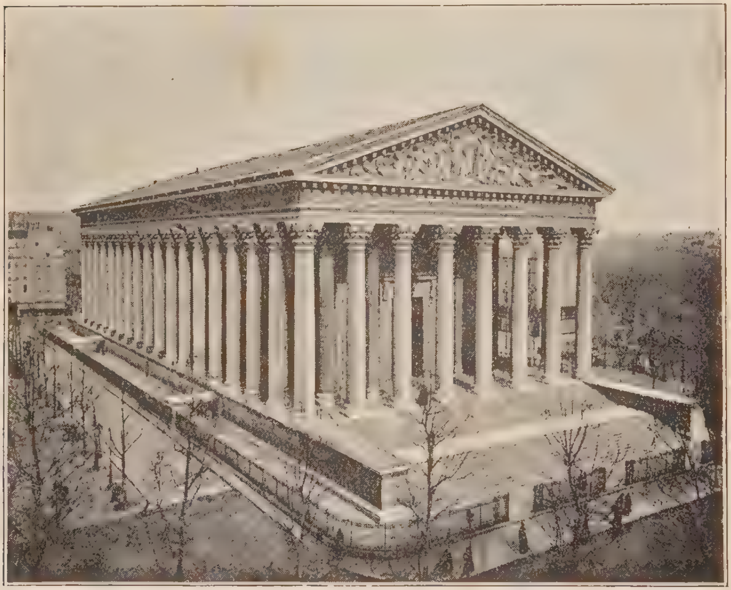

FIG. 120.

This effort was not confined to architecture entirely, but the manners, customs, and even the dress of the people were as close an imitation of the days of ancient

Rome, as the climate and geographical conditions would permit.

Streets and public squares were embellished with columns of victory and triumphal arches, and statues of heroes adorned the parks. The Arch du Carrousel, Fig. 121, shows how closely every detail of Roman custom was imitated, to the exclusion of every original idea, and to the detriment of the architectural advancement of the country.

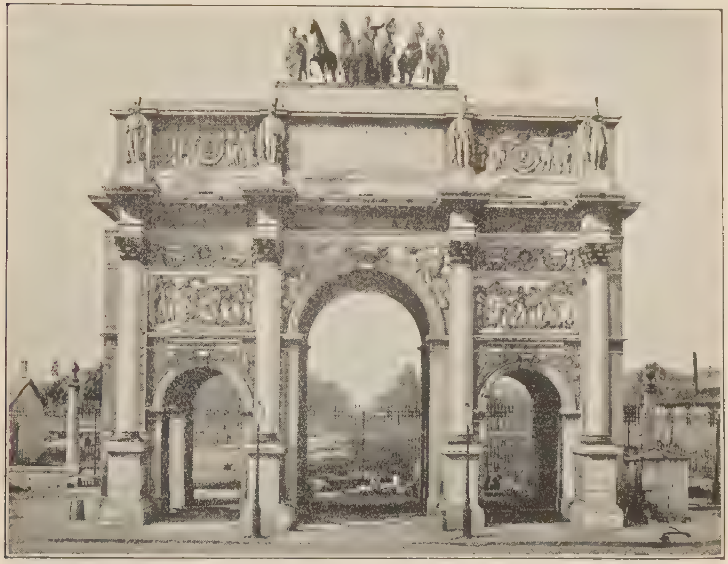

FIG. 121

**143.** In Germany, the Classic Revival wasted little time on Roman forms. This was due partly to the fact that the Renaissance has been so misunderstood, and partly to the inappropriate associations of Roman pomp and splendor with Germany's condition of finances. The long war between the Catholics and Protestants, in the seventeenth century, had nearly ruined Germany, while it had caused France to become the leading nation of Europe; and the next hundred years added but little to Germany's interests, while France continued to grow in power.

The German's taste then inclined to quiet and retiring ideas, and the recently discovered art treasures of Greece appealed strongly to his instincts. The literary works of the German poets, Lessing, Goethe, and others, diverted the public mind to the study of Greek art, and the discoveries of Stuart and Revett, and their publication of the "Antiquities of Athens," gave the contemporary architects models by which to be governed.

**144.** Leo von Klenze then erected, at Ratisbon, a monumental structure known as the Walhalla, which was exteriorly an exact model of the Parthenon, two-thirds the dimensions of the original at Athens. This architect saved himself an immense amount of responsibility by copying so celebrated a building, and while praise may be due him for the accuracy of the reproduction, he is certainly deserving of the most severe criticism for the erection of so classic an edifice on a lone hill, where its sole surroundings are the high roofs and slender spires of the German villages.

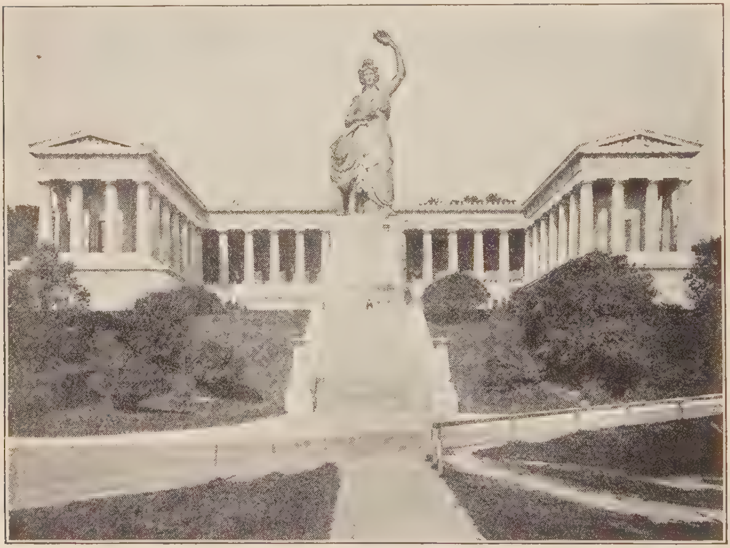

FIG. 122.

**145.** The Ruhmeshalle, at Munich, Fig. 122, is **E**-shaped in plan, with a colossal statue of Bavaria occupying the central portion. It was erected to contain the statues, and was dedicated to the memory, of Bavaria's great men, and, though not copied after any Greek building, it is purely Greek in design, and correct in form and proportion down to the smallest detail. It forms a fitting background, and adds dignity to the colossal figure in front, without appearing unsuited to its surroundings, as did the Walhalla as above explained.

**146.** The Glyptothek, or sculpture gallery, at Munich, Fig. 123, was designed by the same architect as the Walhalla, but though not a servile copy like the former structure, its most original feature, the Ionic portico, is its strongest defect, being out of proportion and distinctly unrelated to the detail of the surrounding parts.

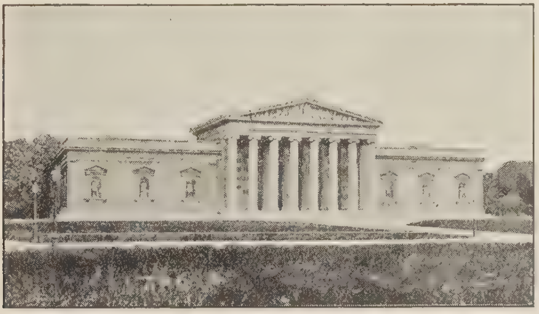

FIG. 123.

**147.** In the city gate of Munich, Fig. 124, this architect was much more successful. The somber dignity of the Grecian-Doric order appears well suited to the purpose of this structure, and seems to have been well understood in principle by the architect. The design, though thoroughly Greek in spirit, is at the same time sufficiently modern to prevent the feeling that the intent and purpose of the monument has been in any degree sacrificed in order to suit the conditions imposed by the style.

**148.** The Greek Revival in Germany, presents the aspect of a sincere striving for beauty, on the part of a few talented architects, who labored under the false impression that the forms and details of an ancient and extinct civilization were suitable to the conditions of society as it existed at the close of the eighteenth and the beginning of the nineteenth century. The period is marked by examples of excellent planning, admirable construction, and most carefully studied detail; but it failed from an artistic standpoint through the lack of harmony in social, religious, and political conditions of two peoples living twenty-two centuries apart.

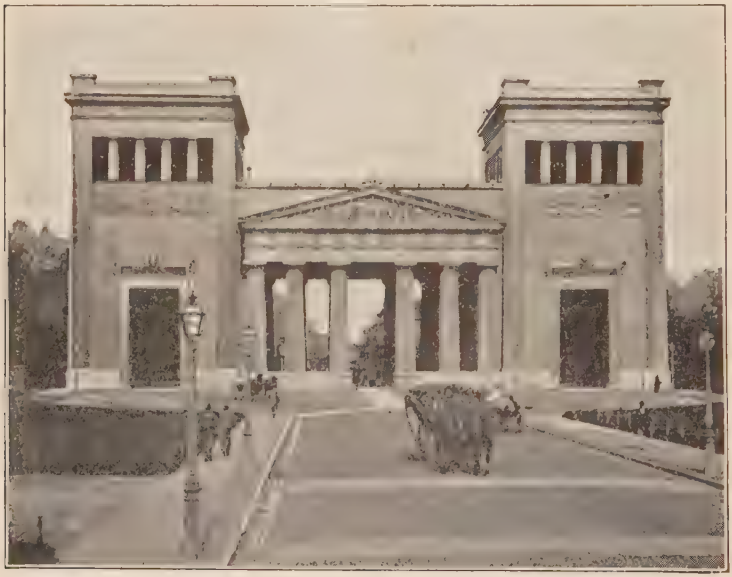

FIG. 124.

**149.** Of the Classic Revival in England there is little in praise to be said. The modified Palladian style of Wren and his successors continued until superseded by the Greek Revival, which never succeeded in combining any two features of beauty and utility. A plain facade, with unmolded rectangular windows, was embellished with a four or six columned Ionic portico and called Greek. Or a street front was erected without any windows, and covered with a sculptured pediment, to establish its style of architecture, while in the rear a multiplicity of windows gave the necessary light. Windows have always been the stumbling block of the revived Greek style, and the application of the revival to a modern structure requires the omission of the windows.

**150.** The Fitzwilliam Museum, at Cambridge, Fig. 125, is a well proportioned structure, whose purpose requires no windows, and therefore fits itself to the style. The arrangement of the portico, the treatment of the pilasters, and the molding of the cornice, is decidedly more suggestive of Roman than of Greek models, showing how inefficient the pure Greek design is to a purely modern purpose.

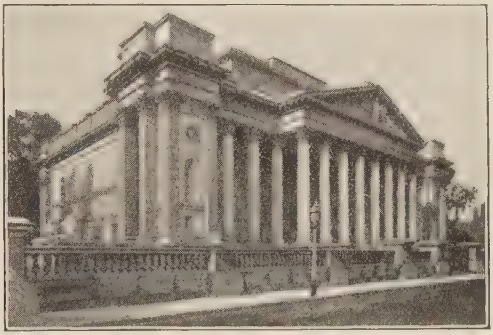

FIG. 125.

**151.** St. George's Hall, at Liverpool, Fig. 126, is a building whose imposing peristyle and projecting porches are decidedly Greek in spirit, though the plan and details are decidedly Roman. The utility of the building, however, is sacrificed to a certain extent, as the colonnade cuts off the light and is an utterly useless appendage, except to stamp the design as belonging to the efforts of the Greek Revival. Thus, as in Germany, the application of the architecture of the age of Pericles to the structures of the nineteenth century, was found to be impracticable, and after repeated efforts, and almost as many failures, the style was abandoned and has ceased to be practised, except in rare instances, down to the present day.

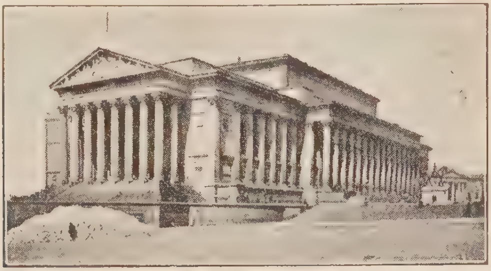

FIG. 126.

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## RECENT ARCHITECTURE IN EUROPE.

**152.** We have now studied the progress of architecture and the development of architectural styles, from days of ancient Egypt to the middle of the present century. We have seen characteristic details in Greece grow out of constructive principles. We have seen the details adopted in Rome, while the structural device which called them into existence is ignored. We have seen the engineering science of the Romans, developed and improved by both the Byzantine and the Gothic systems of construction. But with these styles, *architectural* construction ceases to exist. With the Renaissance, architectural style and architectural construction were separate and distinct considerations. With the Classic Revival, style, construction, and arrangement of plan were each an independent problem, and the dawn of the nineteenth century found architecture in a thoroughly misunderstood condition.

This has been preeminently a century of progress, particularly in scientific, mechanical, and commercial lines, and the demand for utility in every structural detail, has prevented architecture from taking its proper place in the march of progress. Nevertheless the artistic spirit has not been entirely crushed out by commercialism, and the numerous international exhibitions, the increase in the number of museums, schools of art, etc., have wakened a latent desire for something more than merely utilitarian construction.

**153.** It is in France, Germany, and England that we must look for nineteenth century development. Italy never emerged from the style of the Renaissance, Spain lost her power in the beginning of the seventeenth century, and repeated invasions and internal revolutions prevented any architectural advancement; while Holland and Belgium were so concerned in the political changes of Spain, France, and England, that little time was devoted to the fine arts other than painting.

**154.** In France, the existence of the "School of Fine Arts," at Paris, while tending to systematize and unify the national architecture, at the same time prevented a free development of ideas. In consequence, French architecture has adhered to the principles of the Renaissance, though slight breaks have occurred in the progress of a modern Renaissance development. These breaks were in the form of an attempt to introduce the Greek Revival, which failed, and a strong Revived Gothic movement, represented by a very able and celebrated architect and writer, Viollet-le-Duc. The Gothic movement produced no very important buildings, but it was fruitful in the restoration of a great many medieval churches and castles, which would otherwise have gone to ruin.

**155.** The reign of Napoleon III (1852 to 1870) was a period of exceptional activity, especially in Paris. The Louvre was finally completed by two architects, Visconti and Lefuel; the Tuileries was partly remodeled and completed by the same architects; the New Opera House was built by Garnier; and numerous public fountains, elaborate in design and construction, were erected in streets, which were remodeled and extended at this time, making Paris one of the most monumental cities in the world.

**156.** Fig. 127 shows the south facade of the north wing of the Louvre, facing the Place du Carrousel. The treatment of the arcade, between the end and central pavilions, is vigorous and effective, and the two facing wings constitute one of the most notable examples of modern French architecture. Fig. 128 shows the Pavilion Richelieu in the center of the above facade, from the details of which the character of the design may be more closely observed. The ornamental details are extremely refined and beautifully proportioned, and show plainly the influence of the National School of Fine Arts. Nothing in the design of this facade exists there without a reason—either traditional or structural—and all is harmonized according to a well governed system practised in the French school of art.

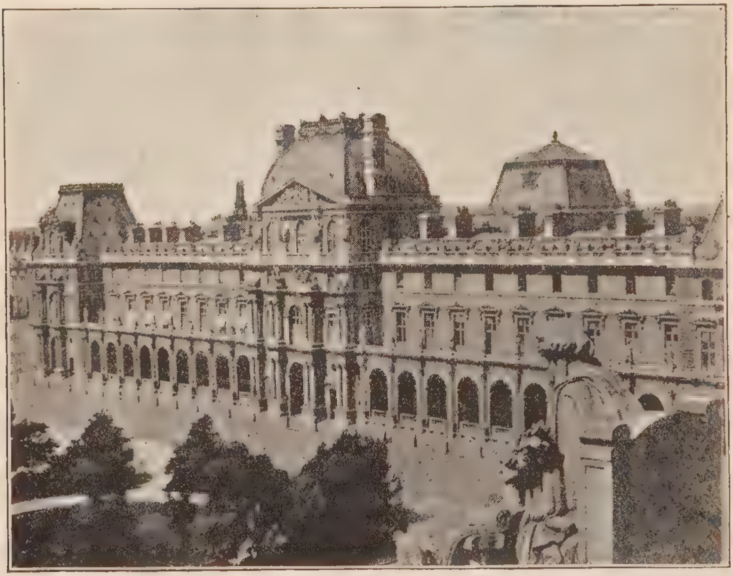

FIG. 127.

There are certain defects, to be sure, but the critic must hunt for them, as they are not glaring, and they are so outweighed by the good points in the design that there can be no hesitancy in commending the design as successful from every point of view.

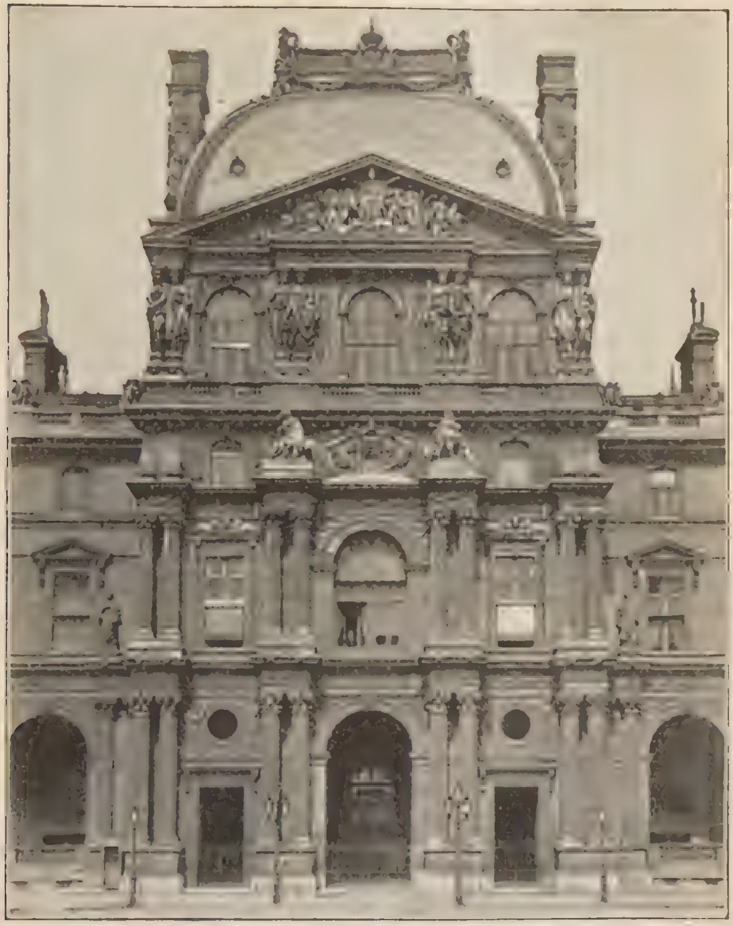

Fig. 128.

**157.** The Academy of Music, or Paris Opera House, by Garnier, Fig. 129, built between 1863 and 1875, stands next to the Louvre in importance as a national monument. It is by far the most elaborate and richly decorated building for amusements in the world, but in purity of detail and harmony and refinement of its design is far inferior to the Louvre. In this structure the public taste for gorgeousness is catered to, rather than the demand of the refined intellect for harmony of proportion. This facade loudly proclaims the sentiment, "The nation is rich and can afford to spend its money on elaborate carvings, bas-reliefs, and painted frescoes." In contrast to this, consider the ancient Greek structures, whose every detail proclaimed, not wealth and egotism, but intellectual development and refined appreciation.

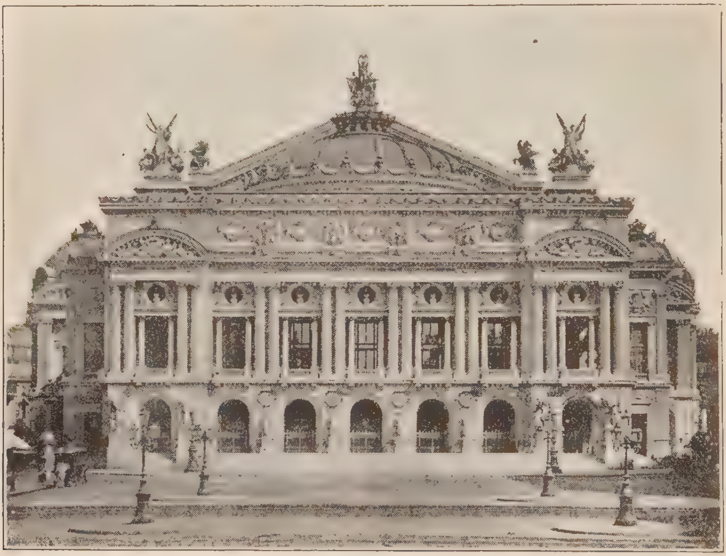

FIG. 129.

**158.** The systematic study required by the National School of Fine Arts, the restrictions of the government as to those who shall practise architecture, and the thorough education of the artisans, whose fathers have followed the same trade for generations back, have all combined to place

French architecture and the French style in design ahead of the rest of the world at the present day. While England has been wavering between two antagonistic styles, and Germany has vainly struggled with her classic forms, France has steadily advanced in the development of a modern school of Renaissance.

## GOTHIC REVIVAL.

**159.** About the middle of the present century, a number of enthusiastic students of British medieval monuments endeavored to revive the Gothic as a national style of architecture. These enthusiasts were bitterly opposed by the practising architects of the Classic Revival, and the warfare became so active that it was a rule in the principal art societies that all discussion of the relative merits of the two styles should be suppressed. The medievalists finally prevailed, and the Gothic style is practised in England at the present day. This Victorian Gothic, however, is not the same as that of the twelfth century.

When the style was first revived, the general tendency of the practice was to make every detail archeologically correct; but it was soon learned that medieval Gothic was as ill suited to modern requirements as the classic Greek or Roman. Between the years 1850 and 1870 the striving for historical correctness of detail gave place to a rational effort to adapt Gothic principles to modern requirements, instead of merely copying extinct styles, and the result is a number of extremely interesting buildings.

**160.** Chief among these are the Parliament Houses, at Westminster, Fig. 130, designed by Sir Charles Barry, in the Perpendicular style. This immense structure is the most successful edifice in the Victorian Gothic style. Its masses are simple, and its detail is well studied and refined, while the entire composition is dignified and imposing. It is defective, however, in the proportioning of its details to the general mass. The former is made to appear insignificant by the vastness of its surroundings, and the two principal towers—one at the angle and the other in the center—are out of proportion to the building and to each other. The central tower would appear much more imposing if not dwarfed by the great Victoria Tower at the angle, while the latter would harmonize with its flanking facade if it were smaller and better proportioned to their details.

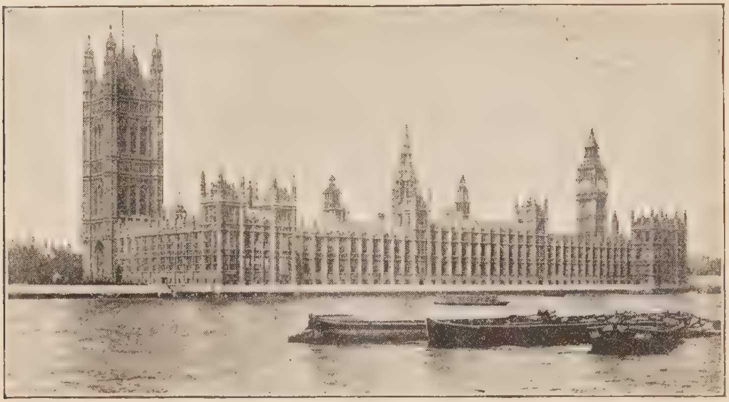

FIG. 130.

**161.** Other buildings designed in this style were inclined to the same excesses, so that at the present day architecture in Great Britain is suffering from the same uncertainty as at the beginning of the century—some architects still favoring the Gothic, while others are designing in the style of the Renaissance, and still others are endeavoring to draw an inspiration from the Revived Classic.

This is not an artistic age, and the striving for originality in design is preventing the advancement of architecture along healthy and rational lines.

## AMERICAN ARCHITECTURE.

### EARLY COLONIAL PERIOD.

**162.** The successful colonization of America was not accomplished until the beginning of the seventeenth century, and the hardships of the colonists were at first so great that little attention was given to architectural development until the beginning of the eighteenth century. Buildings of stone were not undertaken by the early English colonists, though brick structures were erected in the southern and Dutch colonies.

About the beginning of the eighteenth century, the influence of Wren's designs in England began to assert itself to a small extent in the southern English colonies, though the structures were nearly all erected of wood or of brick and wood. From 1725 to the Revolution the population increased along the coast, and with the gradual acquirement of wealth there was an advancement in the character of the architecture, as seen in the dwellings and churches of the American aristocracy. During this period, the development of what is now known as the *Colonial style* took place. It was based upon ideas drawn from the Classic Revival in England, particularly that phase of the revival which appeared during the reign of Queen Anne. The details were extensively modified, however, by the use of wood instead of stone, and by the employment of designers who were not educated and trained in the Old-World architectural traditions. The style, especially in interior design, exhibited the taste and culture of the colonial aristocracy in its delicate and refined treatment of the woodwork, but there were no buildings erected in this style which were of a really monumental character. Stone edifices were very scarce, and the administrative buildings of the principal cities were small unpretentious structures, built within the insufficient grants of the crown.

**163.** The dwellings exhibit clearly the different tastes of the different colonies, though they all possess features of common origin in the mother country. In Maryland and Virginia, which were colonized by a wealthy class of English subjects, we find fine brick manor houses, extensive grounds, which are surrounded by high brick walls, and entered through broad gates of artistic design. The interiors of these southern colonial houses are usually very elaborate; large high-ceilinged rooms, whose side walls are decorated with stenciled or frescoed patterns of the urn and festoon of the Adams brothers, in England. Rich mahogany sideboards of Sheraton design and bandy-legged furniture of Chippendale, together with broad open fireplace, suggestive of the reign of Elizabeth, form characteristics inseparable from the spirit of the design of the American colonial manor house of Maryland or Virginia.

**164.** In New England the majority of the residences were of wood. The plans were more compact, and the exteriors were more picturesque, but they were lacking in the dignity and stateliness of the southern manor. The interior details, wainscots, cornices, stairs, mantels, etc., were essentially the same as in the South, and each showed a skilful adaptation of the classic forms and details to the slender proportions of a wood construction. Externally the orders appear as supporting details for veranda and porch roofs, and in the form of colossal pilasters flanking and subdividing the facades, as in Fig. 131, which is a view of the old Cragie House, at Cambridge, Mass., built in 1757.

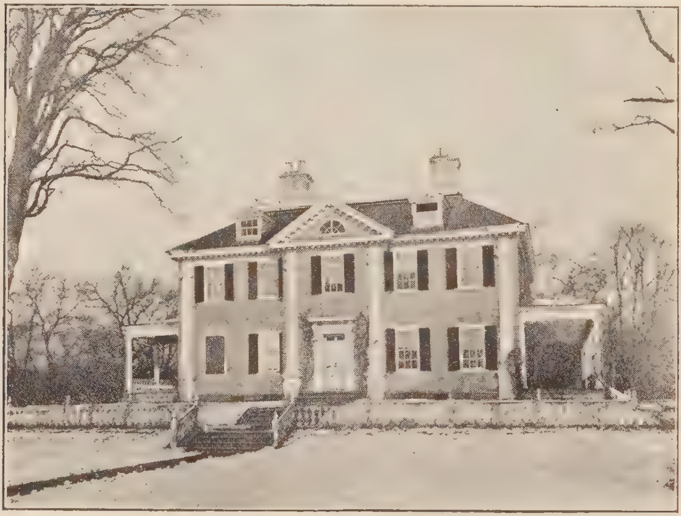

FIG. 131.

The interest in American colonial architecture lies chiefly in the taste and ingenuity displayed in the translation of classic details from stone into wood. The American colonists were of English descent, and, persecuted though they may have been, they loved their mother country, and far from desiring to start any sort of an independent style of their own, they copied their designs from the contemporary English style, and erected in wood what they had not the means nor the skill to carve in stone, and took pride in the accuracy with which they adhered to the details of the parent style.

### EARLY REPUBLICAN PERIOD.

**165.** After the Revolutionary War the new conditions of independence and self-government caused the American people to take a new interest in building projects, and to undertake the erection of structures which should be monumental as well as purely useful. Capitols and other buildings for the national and state governments, and municipal buildings in the cities, were erected at this time, and though the style was after the late Renaissance of Wren and his followers, there was a considerable admixture of French details, due no doubt to the active sympathy of the French people during the war.

The United States Capitol, at Washington, Fig. 132, was commenced in 1793, and consisted of the central portion of the present building, without the dome. The rusticated basement and high-columned portico, together with pedimented windows in the first story, and the square masonry openings above, are strongly suggestive of the facade of Somerset House, Fig. 118, and it is not improbable that Thornton, Hallet, and Latrobe, the successive architects, drew more or less inspiration from that edifice. The building was not finally completed until the year 1830, when, under the supervision of Charles Bulfinch, the two flanking wings were added, which make this monumental structure the largest and finest legislative palace in the world.

The dome is the principal feature, and rises from the ground line to the top of the statue of Liberty which surmounts it, a height of 287 feet, while its diameter inside is 94 feet. It is smaller than the dome of St. Paul's, London, but in point of design is superior to the creation of Sir Christopher Wren. It is also an excellent example of Yankee independence of traditional ideas.

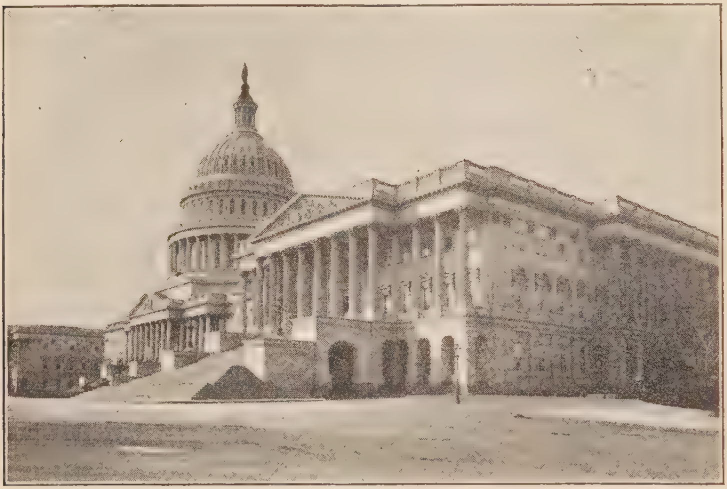

FIG. 132.

**166.** The dome over the Pantheon, at Rome, is a concrete vault supported by massive walls. The dome over Hagia Sophia, at Constantinople, is a masonry construction supported upon four immense piers. The dome over St. Peter's is constructed in two shells, the inner one for interior effect and the outer one for exterior effect. Over the Hôtel des Invalides is a stone inner dome and a lead-covered outer dome of wood, while St. Paul's Church, at London, has an inner dome of stone, an outer dome of wood, and between them a tall cone of brick to carry the stone lantern above the wooden roof. Thus there has been an advancement in the combination of design from an artistic standpoint, and design from a structural consideration, but the advancement has been at the expense of architectural honesty and truthfulness. The exterior dome in these latter-day constructions is not what it claims to be by appearance—viz., the roof over a portion of the interior of the building—but is an exterior roof over an interior ceiling, with no connection or relation to the structural requirements of the interior at all. Down to the building of the United States Capitol, it was traditionally assumed that the architectural dignity of the structure required at least one of these domes to be of masonry construction, in order to be solid, substantial, and fireproof. But the design of the dome at Washington set aside all traditions, and called for a construction of one single material; namely, iron. No wood or stone is used anywhere. The absence of the former certainly insures it against fire, but the details are so suggestive of stone construction, that the design is even more untruthful than St. Paul's. A vast shell of wrought-iron trusses, cast-iron columns, and sheet-iron covering is so treated as to appear an architectural composition of stone; and though the details are well proportioned and refined, it detracts from the harmony to know that those details are products, not of the stone-carver's art, but of the patternmaker's and ironworker's skill.

**167.** The White House, Fig. 133, is the name given to the executive mansion, or residence of the President. This structure, commenced in 1792, is a typical example of the Classic Revival in England. It was designed by James Hoban, an Irishman, and patterned somewhat after the

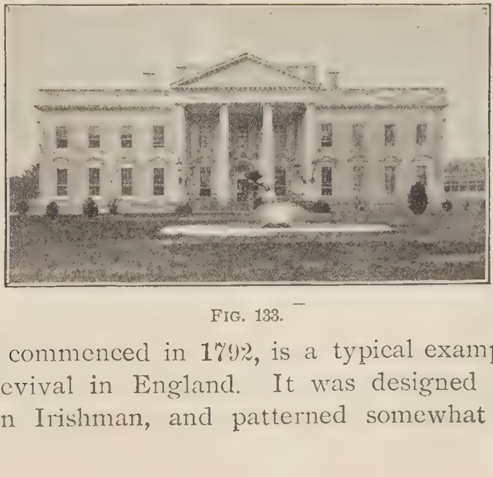

FIG. 133.

house of the Duke of Leicester, at Dublin. This, and the fact that it exceeded in size any private dwelling in America, gave cause for much opposition, and made Congress slow in providing the necessary appropriations. The building is constructed of sandstone, and several heavy coats of white paint, applied to protect the stone from climatic influences, caused the building to become known by its present name.

**168.** The University of Virginia, at Charlottesville, another classic edifice, was designed by Thomas Jefferson, the third President of the United States. The fact that Jefferson was an architect had much to do with the activity in building design at this period.

Another educational institution, Girard College, at Philadelphia, Fig. 134, shows to what extremes the Classic Revival was carried even in America. This building is designed to appear as a Roman temple, 218 feet long and 159 feet wide, and with its columns 6 feet in diameter and 55 feet high, its marble exterior might have rivaled the Walhalla, were it not for the fact that instead of a cella, the colonnade

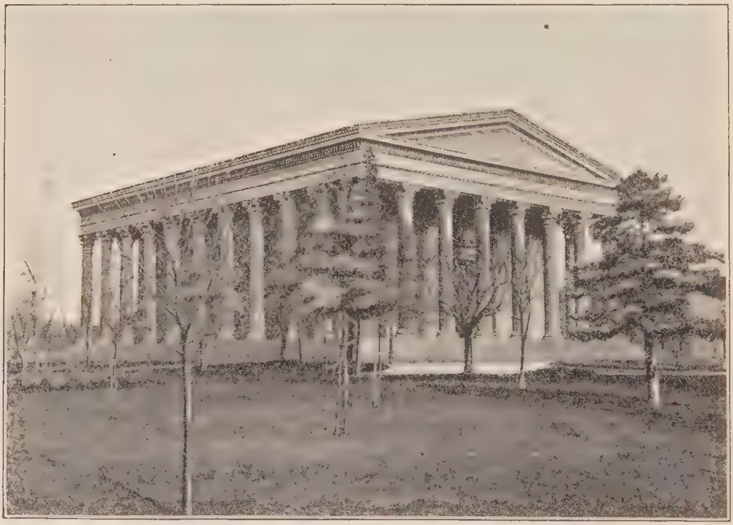

FIG. 134.

encloses a very ordinary two-storied college building. Its details are well executed, however, and its designer, in applying the elements of a Roman temple to the purposes of a modern college, was committing no greater error than his contemporaries on the other side of the sea, who had been endeavoring to accomplish similar impossibilities for three decades.

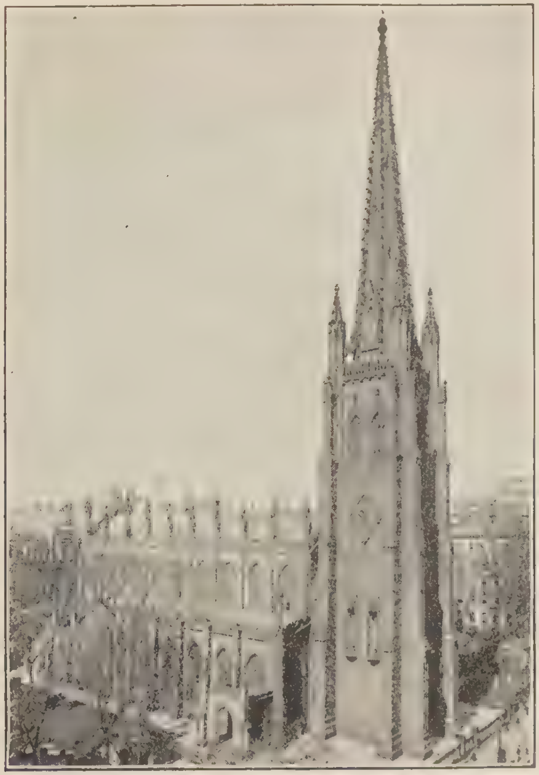

FIG. 135.

Other examples of the Classic Revival in America are the Treasury and Patent Office buildings in Washington, the Mint at Philadelphia, and the Subtreasury and Custom House in New York.

**169.** The decline of the Classic Revival, and the rise of the Victorian Gothic, in England, immediately found its echo in America, and Trinity Church in New York, Fig. 135, designed by Upjohn, in 1843, as well as Grace Church, by Renwick, are worthy examples of modern Gothic work.

**170.** Between 1870 and 1880, the disastrous fires at Chicago and Boston gave unexampled opportunities for architectural improvement in those cities, and greatly stimulated public interest in the art.

The establishment of architectural schools in Boston and New York, and the opening of public museums of art in the principal cities, caused the American public to wake up and be more critical of the things around them, and to demand a higher grade of architectural design.

At this time the personal influence of two men comes into great prominence: Richard M. Hunt (born 1827, died 1895), and Henry Hobson Richardson (born 1828, died 1886). These men, educated at the French National School of Architecture, showed the American public that architecture was a fine art, and not a mechanical trade, and made them understand that the architecture of a country was the key to the education, refinement, and social condition of its people.

**171.** In Hunt's office, many of the most prominent American architects of the present day received their early training, while the works of Richardson exhibited such an independence of the prevailing styles in foreign countries, and at the same time so well suited the purposes for which they were erected, that, had his successors and followers understood the art better, a new style of architecture would likely have evolved.

Trinity Church, at Boston, Fig. 136, is considered one of Richardson's masterpieces. The design is what might be termed Romanesque, not in the sense of an adaptation of tenth-century Romanesque to American ideas, but an application of the Roman-arched construction to the nineteenth-century conditions. Broad, blank wall spaces of rock-faced masonry are left where windows were not required, thereby presenting a rough, gladiator-like expression of crudity, characteristic of the period when the architecture of every country of Europe was feeling its way from the rejected classic arch towards the perfected Gothic vault. This architecture of Richardson's was true in its construction. Everything was real; no false domes and senseless pilasters crowned the roof or graced the walls. Everything existed because it was needed, and details not wanted were omitted, without any attempt to fill blank wall spaces with relieving ornaments.

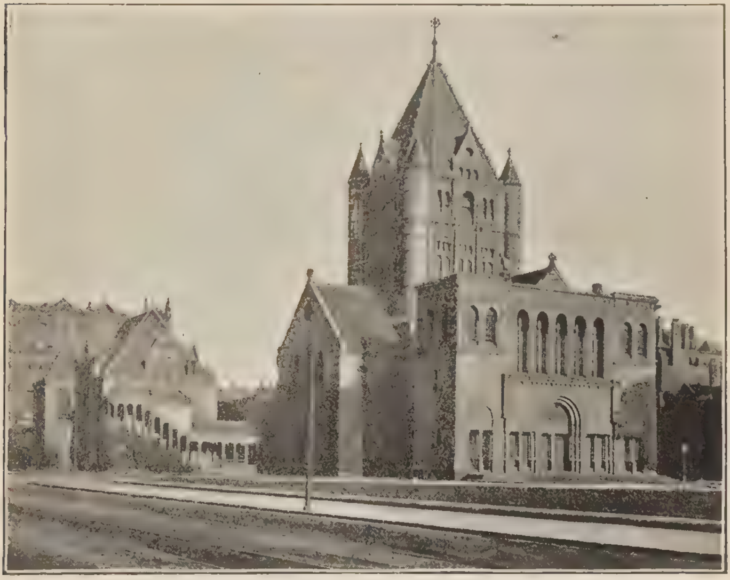

FIG. 136.

**172.** The opening of the French National School of Fine Arts to American students had a very marked effect upon the art education of the American people. Libraries were stocked with architectural works, which would have been too expensive to have been purchased by the individual student, and all the important journals and publications of the day were soon at the service of any one who cared to study them.

The great Public Library, at Boston, Fig. 137, is one of the largest and most important of these educational institutions. It was designed by McKim, Mead, & White, a firm of architects prominent through their adaptation of the design of some of the best buildings of Europe to American uses. The Boston Library was an American rendering of the Library of St. Genevieve, at Paris. The New York State building at the World's Fair, Chicago, by the same architects, was patterned after the Villa Medici (see Fig. 96). The tower of the Madison Square Garden, Fig. 138, is a very clever adaptation of the Giralda, at Seville (see Fig. 108). This adaptation of individual buildings is certainly not the highest form of art, but it presented for the study of the people a variety of good designs, which made them more appreciative of the architectural merits of their cities, than would a lot of more original, more artistic, but less successful compositions than the Boston Library or the Madison Square Tower.

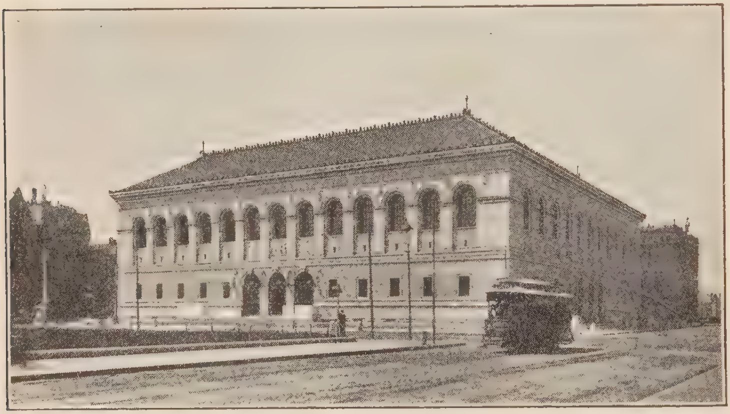

FIG. 137.

**173.** Richardson designed and built about fifty prominent buildings in all parts of the United States, among which are the Court House at Allegheny, Pa.; parts of the Capitol at Albany, N. Y.; Armory at Detroit, Mich.; State Asylum at Buffalo, N. Y.; and also the exhibition building at Cordova, in Argentine Republic, South America.

Richard M. Hunt was more identified with residential architecture than with public buildings, and though his designs for mansions and villas were harmonious and above reproach, and are represented by the most elaborate and expensive dwellings in America, his great service to the profession, and indirectly to the architectural elevation of the country, was in his establishment, in his office, of a regular system of instruction and training for architectural students, and it is to this system, and to those that studied

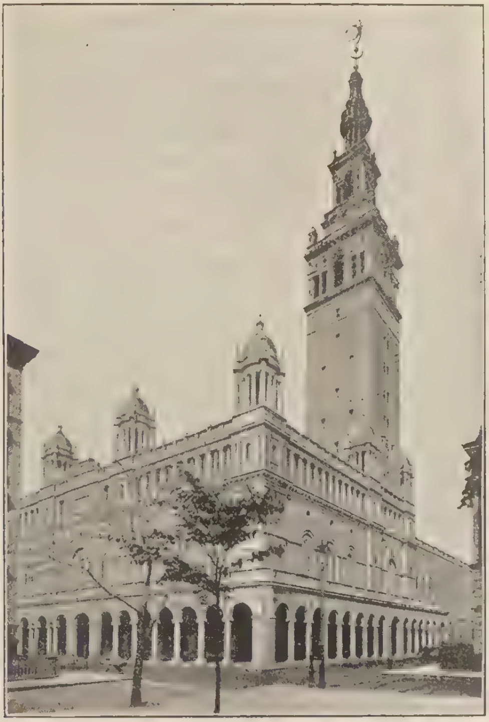

FIG. 138.

under it, that we are indebted for much of the better architecture of the present day. Among these students were Wm. R. Ware, afterwards Professor of Architecture of Columbia University; Henry Van Brunt, a prominent architectural writer; Geo. B. Post, of New York; Furness, of Philadelphia; and Gambrill, who, until his death, was the partner of Richardson.

Each of these men carried into his own practice the systematic style of Hunt's methods of working, and helped to establish in the general architecture of their several localities an appreciation of the value of good architectural composition.

**174.** Hunt's early architectural training was in the *atelier*, or studio, of Hector Lefuel, in Paris, when he was 18 years of age, and he pursued his studies at the French National School of Fine Arts, for nine successive years. During these years, Lefuel was appointed by Napoleon III as architect to complete the northern gallery of the Louvre, the most important feature of which was to be the central pavilion. As a pupil of Lefuel's, Richard M. Hunt designed this pavilion, and it was erected, with but slight alteration, under Hunt's personal supervision, when he was afterwards appointed inspector of the works.

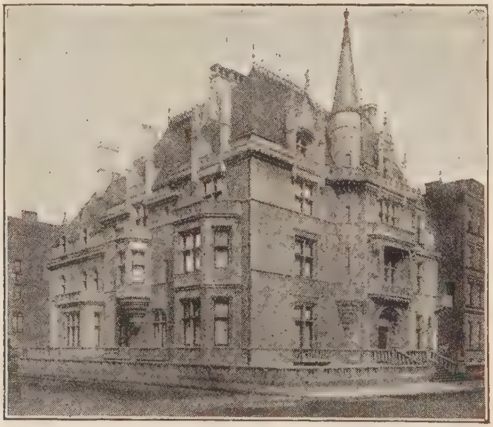

FIG. 139.

Thus it was that one of the most important structures in modern French architecture was designed and erected by an American architect. It is not surprising, therefore, to find Hunt's designs all more or less influenced by the French style and school of design. The residence, or city château, of W. K. Vanderbilt, Fig. 139, is one of Hunt's masterpieces. Situated at the intersection of two of New York's busiest residence streets, it does not fit its position as well as it might with wilder surroundings. Its design is original, though suggestive of the Château of Chenonceau (Fig. 99), or Azay-le-Rideau (Fig. 98), and even in its urban location has a precedent in the house of Jacques Cœur, at Bourges, France, (Fig. 86).

### COMMERCIAL ARCHITECTURE.

**175.** To the nineteenth century, and especially to the two last decades of the nineteenth century, history is indebted for a new architectural structure—the office building. This is essentially an American creation, evolved from the necessities of a centralized commercial trade. Business and professional men have always required offices, but it is only within the past quarter century that circumstances have demanded that these offices shall be localized according to the business or profession predominating in the neighborhood. Lawyers require offices near the court houses; brokers and bankers demand offices near the exchanges; commission merchants, manufacturers' agents, and insurance solicitors each require certain surrounding conditions of trade, to make the locations of their offices desirable; and to supply the ever increasing demand, the multistoried office building has been "invented."

**176.** When, on the corner of Wall street and Broadway, New York, there was built a nine-story office building for the First National Bank (see *a*, Fig. 140), it was considered a remarkably lofty structure, being about half the height of Trinity Church spire, the then highest edifice in the city. Within the past ten years, there have been erected all over

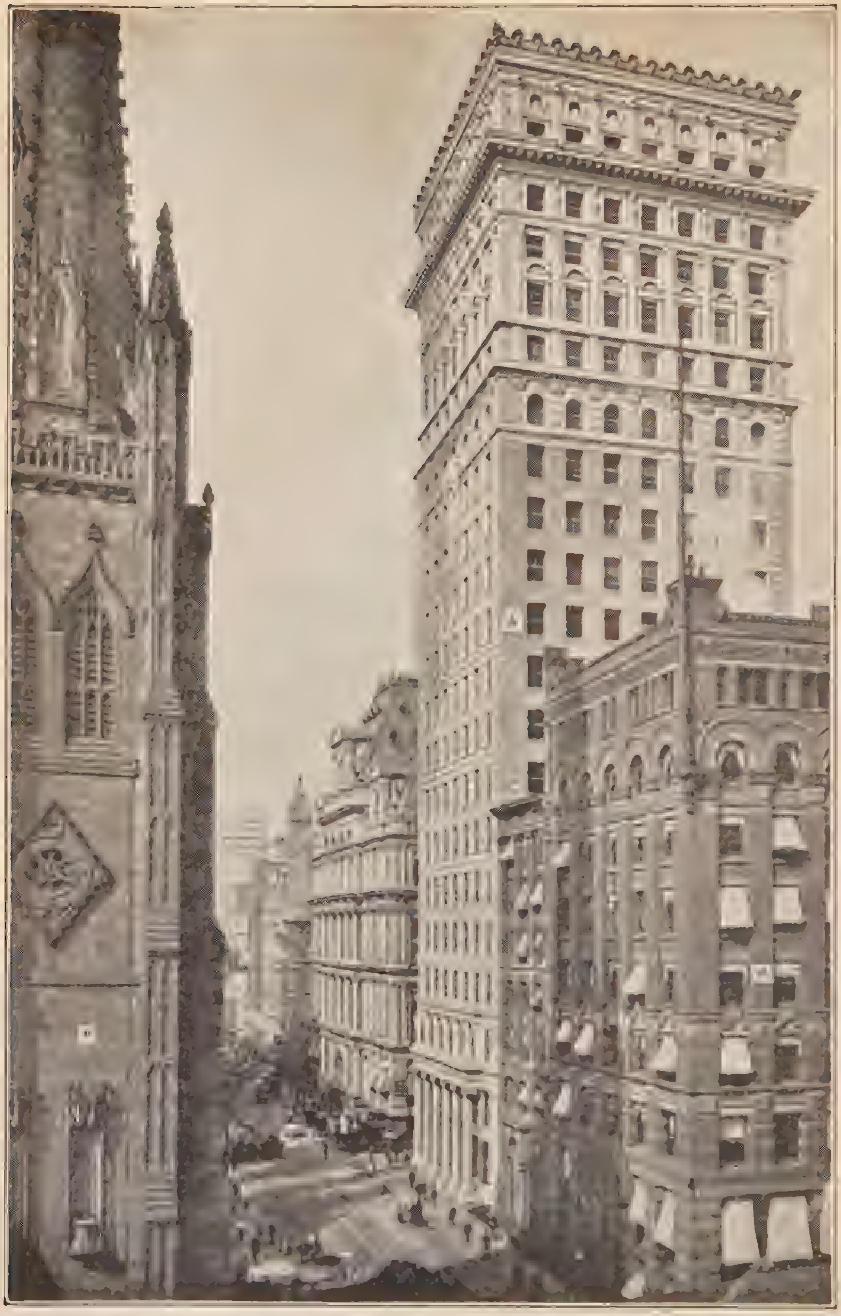

FIG. 140.

the country "sky-scrapers," beside which the old First National Bank Building retires to insignificance. The American Surety Building (see *b*, Fig. 140) is one of these, and though by no means the highest office building in the city, its twenty-one stories loom up well above the nine stories of the bank building, and overlook the uppermost point of Trinity spire itself. The American Surety Building is an excellent example of harmonious design under trying circumstances. A building whose height is five times its width, and whose facade can be viewed squarely from a point only 80 feet distant, does not present an easy problem in composition and design; but the well placed string-courses and cornices, and the systematic emphasis and grouping of certain openings, divide this tall mass into pleasing proportions, and give it dignity, breadth, and harmony.

**177.** American architecture reached its climax in the World's Fair, at Chicago, in 1893. Here were exhibited, not only the products of the arts and sciences of nearly every nation on the globe, but assembled in harmonious juxtaposition were buildings designed and erected by the best architects in the United States. America had never been looked

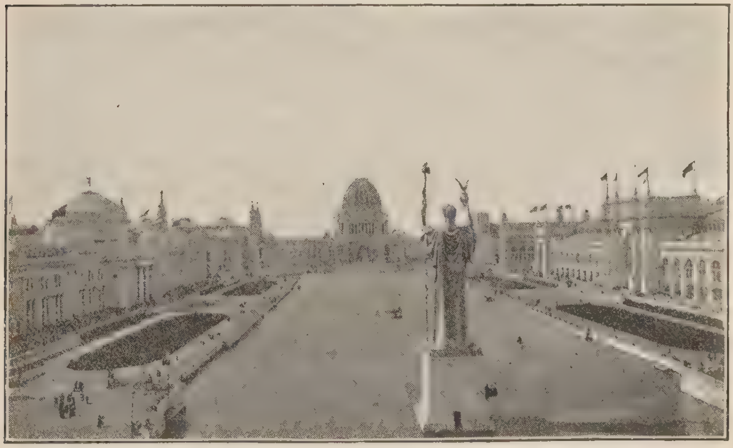

FIG. 141.

upon by her foreign sisters as of much importance from an architectural standpoint, but the president of the Royal Institute of British Architects, in a speech before that society, pronounced the Court of Honor at the Chicago exhibition (Fig. 141), "the grandest thing architecturally the world had seen since the age of Pericles."

## CONCLUSION.

**178.** The review of a larger number of buildings erected in the nineteenth century would show no idea or development of greater importance than those already referred to, and as architects today are no nearer the invention of a new style than they were two hundred years ago, the examples given are sufficient to show the progress made in this direction. The questions are often asked, Why do we copy ancient forms and never invent new ones? Why must all the nineteenth-century architecture be a reproduction of the Renaissance, Romanesque, or Gothic styles, and never strictly original and peculiar to the present time?

These questions may thus be answered: It must first be borne in mind that there are but two original styles of architecture—the *Pagan* and the *Christian*, otherwise called the *Classic* and the *Gothic*. All other styles, at the best, are but diversified forms, affected by local combinations, mannerisms, and individual caprice. So that the natural tendency in the practice of architecture has always been little more than imitative of the past, a radical change having been accomplished only through the inspiration or enthusiasm of some grand religious, political, or social revolution. The conquest of Greece by the Romans gave birth to the Roman style of architecture, while the emancipation of the Christians by Constantine was the corner stone of a beautiful style soon to be perfected. The Romanesque shows us the gradual education of the people, and the Gothic expresses the grand thanksgiving of the enlightened soul and its glorification of God.

The enlightenment and education of the people towards the close of the fifteenth century enabled them to read for themselves what had heretofore been taught only by the priests; enabled them to judge for themselves what before had been interpreted only by the clergy. Different opinions thus arose, which led to a division of the church, and the demoralizing effect of this schism is shown in the character of the contemporaneous and subsequent architecture. The introduction of pagan forms and details, the imitation of Roman luxuries and extravagances, mark the character of the Renaissance period, while the Classic and Gothic Revivals show the tendency of one class towards the intemperate admiration of heathen art, while the other class, led by the church, endeavored to instil into the world at large a proper love and admiration for Christian forms.

Thus, we see that in modeling after preexisting forms, we are simply following the course which has been pursued ever since the infancy of art, and if the development of a new style in the future depends on a repetition of events similar to those which have caused architectural revolutions in the past, the prospects for its fulfilment are not very assuring.

# ARCHITECTURAL DESIGN.

## NATURE OF DESIGN.

### INTRODUCTION.

**1. Design** in general as applied to architecture treats with the disposition of the parts so as to please the senses, in contrast to the mechanical arts, where *design* means proportioning and grouping of parts to serve some useful end. Architectural design is complicated with practical considerations of such magnitude and importance, that they are usually set forth as constituting the entire subject, to the exclusion of esthetics entirely.

The most important of these considerations is *utility*, as at the present day nearly all architectural work is for some useful purpose. In past ages, when architecture found expression chiefly in structures erected as dwellings for the gods, utility counted for less, and the considerations of beauty and reverence were paramount. But now we must build houses, town halls, and office buildings, and develop our design from such stern utilitarian demands as minimum cost, maximum floor area, light, access, etc. Sentiment, too, sometimes plays an important part, either religious or domestic, or that of pride, or even ostentation, and the architect is expected to combine a dozen points of utility and half as many sentiments in a single design.

The next consideration is *construction*, both actual and

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apparent, for even the untrained eye will detect a post or beam which looks too small for the work it is doing, and in these days of cast-iron columns and rolled-steel beams, construction which may be actually sound and reliable is likely to appear too weak. This brings us to another practical consideration—that of *material.* Cost, location, and sentiment may combine to dictate whether our edifice shall be erected of stone or brick, bronze or iron, marble or plaster, and all these considerations are to be satisfied before we can make one step towards the *composition* of our design.

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## COMPOSITION AND DESIGN.

**2.** To define the exact meaning of the terms **composition** and **design,** and to clearly explain the relation each bears to the other, is a somewhat difficult task.

The term *design* is usually applied to express the origin of some particular art form, such as Egyptian design, Renaissance design, Gothic design, etc.; while *composition* is the preparatory operation of the act of designing, the mental grouping of the parts of a design, and the proportioning of those parts, one to another.

Composition has nothing to do with the origin, history, or symbolism of any form, but deals solely with the outline of the mass and the general effect, exclusive of detail, ornament, and finish.

A well designed building is one where the whole mass, considered as a solid block, is of pleasing proportions and outline; the arrangement of its openings and wall spaces, and its high lights and deep shadows, are well studied; while the ornamentation of its details is sufficient to attract the eye to the beauties of its proportions, but not so excessive as to distract the observation from the composition of the whole.

Good composition is in itself an art. Its laws have been determined by a close observation of the methods of working of the best architects of all ages—precisely as the rules of grammar have been systematized by a careful study of the way in which all the best writers have written. Subsequent generations have been guided by these studies, following the ancient examples in all that they considered good, and avoiding such parts as their tastes have dictated.

**3.** Let us first consider the nature of the problem involved in architectural composition. What are we trying to accomplish when we *design* a building? What is the fundamental problem before us in every case? To what end do we work, and how do we start to reach it?

Our client demands a structure, the utility of which shall be in no way impaired, in order to secure an artistic effect. Our taste requires that the design of the building shall express the purpose of its existence, be pleasing to the eye, and be an ornament to the neighborhood in which it is erected. Now, shall we surrender entirely to the utilitarian conditions and let art have no place in the design? Shall we have a minimum regard for utility, and sacrifice convenience and stability in the endeavor to make our edifice appear a work of art? Or, shall we harmonize these conflicting considerations of beauty and utility, and reconcile the practical needs with our esthetic demands, so that neither need be sacrificed to the other? This is the ideal solution of the problem and the only one deserving consideration. We clothe the masonry or carpentry skeleton so that the form pleases the eye, while the proportions perfectly accommodate the necessities of construction and utility. This is what architecture seeks to do, and wherever it fails in this, it fails in the fulfilment of its purpose.

To obey the unalterable laws of statics, and carry out the artistic requirements of proportion; to make the necessities of the internal planning the very means to external dignity and beauty, securing the latter by means of the former and not in spite of it; to bring success out of the stern demands of the utilitarian client, by making those demands themselves minister to the beautiful—such is the task of the true architect. Every noble design accomplishes this to a certain extent, and the composition approaches ideal perfection in proportion as these requirements are harmonized. Sometimes, the artistic temperament, if unrestrained by technical education, will give loose range to its conceptions, subordinating thereto convenience, propriety, and even stability. On the other hand, utility alone receives attention, and the structure becomes a mere work of engineering, possessing no more architectural effect than a railroad embankment.

**4.** A common brick factory, such as shown in Fig. 1, furnishes a fair example of the first so called solution of the architectural problem, while the magnificent colonnade of the Louvre (see Fig. 106, *History of Architecture*) serves as an illustration of the second. The brick factory makes no claim to being other than an enclosure to some manufacturing plant, and the colonnade of the Louvre is not required by any consideration of practical use; it is added to the palace solely for its own sake, namely, effect. It certainly is beautiful to look at, but good planning and rational construction are both sacrificed to secure it.

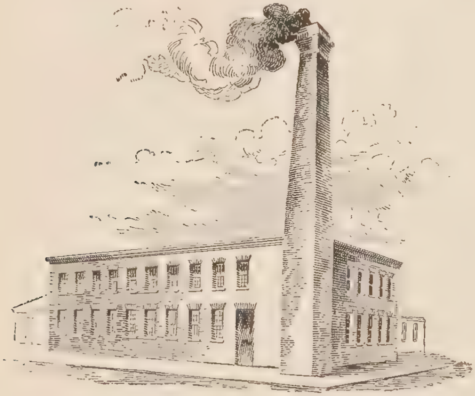


FIG. 1.

The third and ideal solution, as above stated, has been the aim and effort of all architects in all periods of art. Some have leaned a little more to the practical, and others towards the esthetic; but it is plain to be seen, in all great architectural works, that the effort has been to blend the two and to surrender to neither.

With this conception of architectural composition, we have a proper idea of the work of an architect. The study and preparation of a design, from this point of view, is intellectual work of the highest order, far different from the mere drudgery of fitting various rooms together and surrounding them with an exterior that will produce the most showy and startling elevations. This lofty point from which we approach our task makes it far more difficult than from any other point of view; but our work acquires dignity and importance by it, and we discover that the smallest rural cottage and the palace of a king furnish problems differing only in degree and not in kind. In each are certain unalterable conditions of practical necessity. In each are certain artistic considerations of form, of proportion, and of ideal beauty which must be combined in a whole, every part of which shall satisfy both sets of conditions.

**5.** Reference to architectural history may serve to make this clear. Such history begins in the Valley of the Nile, and there all the Egyptian architecture is most powerfully impressive because of the predominance of religious symbolism and the ideas of sublimity and eternal duration. The laws of statics and practical convenience are not disregarded, but are made use of with tremendous excess of material and strength. The ruins of the temple at Karnak (see Fig. 3, *History of Architecture*) make one stand speechless with wonder and awe. Its columns and masses of masonry produce an overwhelming impression of grandeur and power. It is not good engineering—nor even rational building—but it is stupendous. And yet, though much smaller in every dimension than these gigantic Egyptian ruins, the Parthenon at Athens fascinates and commands the admiration of every one by a spell much more potent. All cultivated minds yield to its beauty the tribute of their unstinted admiration; because, even in its ruins, the Parthenon perfectly fits its surroundings, meets the requirements of its original purpose, and satisfies the sense of proportion and form.

**6.** The architecture of the Romans, in contrast to this, shows that they did not understand the intimate relations between fitness and beauty as well as the Greeks did. The

Roman design combines fitness and beauty, but each has received a separate and conservative consideration. Its beauty is entirely superficial, not contradictory to utility or stability; but, with the exception of the vaulting, it is not incorporated into the fabric of the structure itself. This is most clearly shown in the *orders* and their combination with the arch. No principle of construction is sacrificed to the beautiful combination of straight and curved lines, but one never feels that these are the outcome of the needs of the building, as with the Greek orders. In Byzantine art there is a return to the principles of the Greeks. The structures we meet with here are examples of excellent engineering, wrought out by artistic minds. The necessity of every vault and pier is evident at a glance, but these same vaults and piers might have been arranged by less artistic hands and have been the direct reverse of the well proportioned and stately structures they are. And yet this stateliness is wholly independent of the ornamentation with marble and mosaics, with which the piers are incrusted, but is the direct outcome of wise scientific construction.

The marbles and mosaics play the same part in Byzantine as the orders do in Roman architecture. Strip them off, and the Byzantine building still retains a certain beauty born of the dignity and grace of the proportions of its parts; but similarly strip the Roman buildings, and they look naked and desolate.

As a matter of fact, the real importance of Byzantine architecture lies entirely in its system of *composition*, apart from its system of decoration. Here the *construction* is the starting point and the basis of its architectural effect, and this system is the same that controlled all medieval buildings except those of Italy, where the old Roman system of design retarded its influence. The aim of the architect, during the middle ages, was not to construct an ugly shell, to be subsequently concealed or embellished, as are most of our modern buildings, nor on the other hand, was it to mold practical requirements so as to fit certain chosen forms, as the Romans had done; but his purpose was to construct rationally, and to study the construction with a constant regard for its decorative effect. In medieval architecture the requirements of the *vaulting* were in nearly every case the cause of every feature of its design, and the alliance between beauty and utility in medieval work is almost as wonderful as in the Parthenon itself—though we can hardly compare buildings of such different periods or styles, on account of the difference in their origins, the Greek starting from conceptions of pure beauty, and the Gothic from conceptions of good construction.

Both styles, however, unite both conceptions in the final results, though these results were widely different, on account of the different conditions—social, intellectual, religious, and practical—to which each owed its birth. The architecture of the Renaissance period is still different from either of these.

**7.** Though they adopted the whole scheme of Roman art, the Renaissance architects clung for a while to the methods and expressions of the medieval builders. Moved by the general current of popular thought, they turned to classic art, as the scholar turned to classic literature, and adopted the Roman architecture, without a thought as to the circumstances of its origin.

Caring little for the formal grandeur and monumental dignity of this borrowed architecture, the Renaissance architects applied it to their own uses and gave it a freedom, plasticity, delicacy, and variety entirely unknown in Rome itself. During the reign of Francis I in France, we find a most curious display of Gothic ideas and Gothic composition set forth in classic language. Columns, pilasters, and entablatures are most fancifully and freely treated, as shown in Fig. 101, *History of Architecture.* The works of this period are full of grace, originality, and refinement, and are well planned and wisely built. The new forms fit their places perfectly, and require no forcing of the plan or construction to fit them to a set of forms ordained in advance.

At the same time, the orders, although useless as an adjunct to the construction, were used so freely as not to interfere with the composition in the least; that is to say, they were used more as a suggestion of a scheme of design than as an absolute model which is not to be deviated from. The early Renaissance architects designed for their structures a column and a capital that was somewhat like the Roman Corinthian, but was not an exact reproduction of it. They used the model freely, but altered it to suit the requirements of its new position and modern surroundings. The foliage on the Roman Corinthian capital was the classic acanthus; while the foliage on the early French Renaissance capital was the grape, ivy, or other leaf up to that time used as a Gothic emblem.

In the early Renaissance work, the composition is as good and rational as the Gothic from which it sprung, and in many cases it is broader, more dignified, and more refined.

In the later Renaissance architecture, we find the stiffness and formality with which we are liable to identify this style of art. Constant study of the works of Vignola and Palladio had caused the architects to model their designs to suit the orders, instead of subordinating the classic detail to the primary requirements of the modern design. Their main idea seemed to be that the more columns and pilasters the building displayed, the grander and more dignified was the effect, entirely overlooking the fact that what was originally designed for amphitheaters, temples, and triumphal arches, was scarcely applicable to cottages, villas, and noble mansions. And while they sacrificed propriety and convenience to this supposed symmetry and false dignity, the real element of beauty in their works suffered still more from a decline in the skill and taste of their artists.

The designs of the earlier part of this period were refined and elegant, but the coarse lavishness, and the frequent vulgarity and monotony of the Rococo and Louis XV periods, which replaced this refinement, express the general degeneration of the times which followed. Yet degenerate though they were, there is much in these works worthy of study.

From Roman to Gothic the trend of architecture was from mass to detail—from excess of material to economy of material, and from the ideal design to the practical use. Through the Renaissance to the Rococo there was a tendency towards a return to mass and massiveness, and towards ideal form; but from then till now the trend has been steadily in the direction of economy of material and a utilitarian conception of design.

**8.** It should now be apparent from the preceding considerations, that the all-important thing in architecture is neither *style* nor *originality*, but simply *beauty*—beauty associated with, and conducive to, the very best construction, and yet in itself paramount. It should also be evident that beauty is not exclusively possessed by any one style, and that no particular style is worthy of study beyond all others. Every building is to a certain extent good, in which utility and beauty, strength and grace, construction and composition are united in one whole, so as to please both the intellect and the artistic emotions.

## THE ELEMENTS OF BEAUTY.

**9.** No man has ever been able to give a concise definition of *beauty*. Long essays have been written upon what constitutes the beautiful, but none of them has definitely and comprehensively defined the subject. The fact is that beauty is simply an emotion or sensation produced by a combination of forms, the sight of which creates pleasurable impressions in the mind. Beauty itself, then, cannot be defined clearly, any more than can the emotions of joy, sorrow, or pain; but the underlying characteristics of the forms which produce the sensation of beauty can be studied and compared. If an architectural composition can be beautiful or not beautiful, according to differing conditions, then we must learn what the underlying principles, which determine these conditions, are.

The elements of beauty may be considered as embracing:

(1) the expression of unity in variety; (2) the activity or presence of rational or spiritual personality; (3) perfection of form.

The *first* is the principle that was recognized by the ancient Greeks. Their temples were composed of a multitude and variety of parts, but the expression of *unity* was maintained throughout and no part could be removed from the composition without impairing the beauty of the whole.

The *second* principle is the one practised by the Gothic builders, who imbued their works with a feeling of the presence and personality of the living God.

The *third* principle is characteristic of the later Renaissance period and of the present day. Besides these principles, there are the elements of utility, delicacy, and grandeur, each influencing the general principles to a greater or lesser extent, according to circumstances. These may be best illustrated by more commonplace applications.

**10.** A woman, richly dressed and reclining on a cushioned lounge, within a brilliantly lighted drawing room, may, with her surroundings, present an impression that excites the mental emotions of the beautiful. The same individual, however, in the open street, during a pouring rain, would, by the impropriety of her dress and adornments, destroy the emotion of beauty entirely. On the other hand, were she wearing a mackintosh and walking under an umbrella, the fitness and utility of these details, though not expressive of beauty, would not discord in the mind as in the previous case. In the French Renaissance period, a mode of decoration frequently met consisted of the capital of a pilaster formed by two carved figures of Cupid, whose uplifted hands supported a delicate architrave of floral design or simply of festoons. These delicate designs impressed the mind as beautiful—not because they suggested any historical architectural form, for they did not; but because there was propriety and fitness in the wreaths and festoons being held in place by the baby figures. But the Jacobean period in England, when similar Cupids were caused to occupy the top of a bracket or window mullion, and upon their shoulders and outstretched hands support the lintel and two or three upper stories of the building, the idea became ludicrous and lost all power of exciting an emotion of beauty.

**11.** The elements of delicacy and grandeur exist only when the design is either inferior or beyond the scale of what is usually understood as beautiful. The carving of the above mentioned Cupids or the molding of the frieze they support may be delicate and refined to the greatest degree, and yet, though pleasing, fail to stimulate the emotion of beauty. Such a composition is usually called *pretty*, it being a trifle frivolous in its conception, or lacking somewhat in dignity. On the other hand, where sturdy columns support elaborate architraves and superimposed orders lead the eye along through countless arcades, or when massive buttresses receive the thrust from the lofty vault over the nave, and pinnacles and crockets unnumbered profile their outline against the sky, the emotions exceed all idea of beauty and the work becomes *grand*, *imposing*, or *magnificent*.

## COMPOSITION.

### UNITY.

**12.** As above stated, *composition* in architecture deals only with outline of mass, and grouping of parts; the grouping of the parts being such that it gives to the whole design an expression of unity. Fig. 2 shows six equal lines drawn at random without unity, while Fig. 3 illustrates how the same lines may be united by the method of their arrangement. This arrangement need not necessarily be symmetrical, so long as all the minute details are grouped in one whole mass. The great Gothic cathedrals are particularly unsymmetrical,

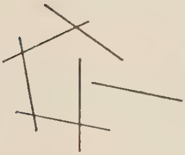


FIG. 2.

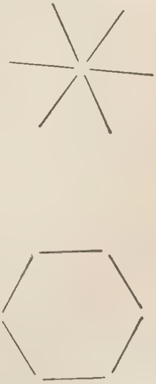


FIG. 3

yet their details are so grouped as to produce an impression of perfect unity.

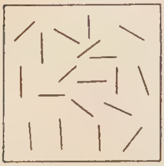


FIG. 4.

Another method of producing unity of impression is to surround the detail with objects of more importance, as illustrated in Fig. 4, where the random lines are unified by the enclosing rectangle. In Fig. 5 the lines are grouped to form a series of rectangles and then grouped in one large rectangle to unite them. This principle is observed in the facade of the Foscari Palace in Venice (see Fig. 82, *History of Architecture*), where the minutely carved windows and tracery are framed in a wall mass to give them unity and repose.

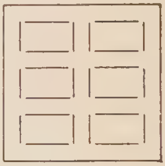


FIG. 5.

**13.** If objects are arranged at regular intervals, even though the grouping may be good, the impression of unity is not produced unless there is an effort made to define the point where the repetition ends. Thus, in Fig. 6, the lines are well grouped and evenly spaced, but the impression is one of *continuity*, but not of *unity*. The mind grasps the outline only partially and feels that the repetition is unlimited, unless there is some detail at each end to stop the continuity and produce a feeling of repose. The wing of Louis XII in the Chateau de Blois exhibits this treatment very plainly, and as shown in Fig. 101, *History of Architecture*, the flanking-stair towers at each end of the colonnade and repeated dormers stop the feeling of continuity and unify the composition.

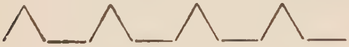


FIG. 6.

The design should always be in repose; that is, there must never be an uncertainty as to where the eye should rest. If we study a noble building, we should judge its entire mass as a whole, and if the secondary details are so badly grouped that the eye wanders from one to the other without deciding which is the most important, there is something wrong in the composition and the building lacks repose.

**14.** Architectural composition consists primarily of two general processes, in each of which the consideration of unity is of the greatest importance. The first of these processes consists of assembling numerous adjacent details into one mass or group, as shown in the diagrams, Figs. 4 and 5. This process is called *grouping*, and is of paramount importance in giving an expression of *unity* to a number of separated parts. The second process, while apparently antagonistic to the first, is in reality part of, and subordinate to, it. This consists of the separation of the building as a whole, into horizontal masses of definite relation to each other. This process is called *subdivision*. In a general sense, then, the term grouping may be considered as referring to vertical elements only, such as gables, spires, chimneys, etc.; while subdivision is used in connection with the horizontal details, defined by the cornices, belt and sill courses, or the grouping of the stories of the building. After the grouping of the component parts of the entire structure comes the grouping of the details, the same rules applying to the minor parts as to the main structure itself.

### GROUPING.

**15.** In assembling subordinate details to secure unity of mass, there are three groupings which completely satisfy the mind as to a sense of unity. One single mass always looks well alone, unless improperly subdivided or surrounded by discordant parts. Conspicuous and well defined *oneness* is characteristic of most of the great architectural monuments of ancient times. Oneness is not the same as unity, but means a mass consisting essentially of one part; while unity describes a mass wherein many parts unite to constitute a whole. It is not strictly correct to speak of a group of *one*, but is necessary here, in order to properly emphasize the importance of this singleness. The pyramid of Cheops, the Parthenon, and the Farnese Palace (Figs. 1, 20, and 94, *History of Architecture*) are examples of this oneness of feeling, as distinguished from the pylons of the temple of

Philæ or the Propylæa at Munich (Figs. 6 and 124, *History of Architecture*), which are each composed of two parts, or a modern country house that may be composed of eight or ten parts. The Hotel des Invalides is another example of unity presented by one general mass. The tendency of the outline of this building is pyramidal and emphasizes the singleness of its character.

**16.** A group of two things can be made to look well unless there is too great a difference in their form or size, or unless they are unsatisfactorily linked or united. The towers of Notre Dame Cathedral (Fig. 78, *History of Architecture*) are excellent examples of unity produced by a group of two, as is also the western facade of Westminster Abbey and the Propylæa at Munich (Figs. 77 and 124, *History of Architecture*). The Cathedral at Florence (Fig. 87, *History of Architecture*), however, does not present such a satisfactory appearance. The two most prominent elements of the design, the dome and the tower, are too unlike to be successfully united, and the impression is lacking in repose.

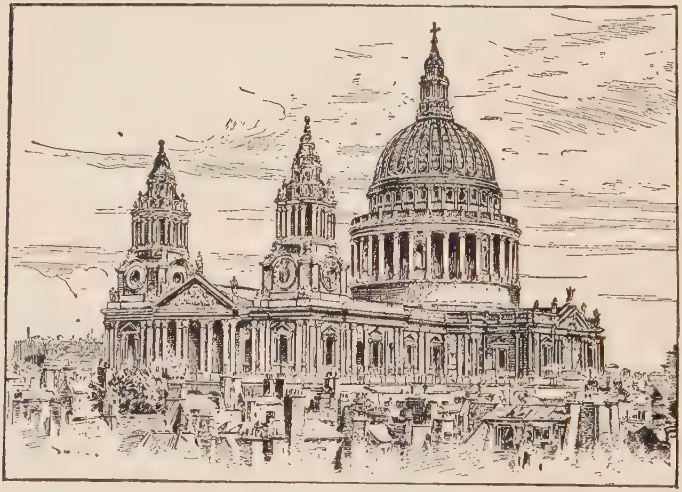


FIG. 7.

**17.** A group of three things usually looks well, but the group must not be of principal details of a uniform size. Three arches in an arcade, three windows of equal proportions, or any three details of minor importance can be grouped without difficulty; but three equal towers as the main mass of the building, or three domes in the roof, or any three elements of equal importance would be impossible. In a group of three important elements in any design, one of the three should be the largest, or if two must be of equal size, the third should be subdued in order to unite them in a group of two. When one of the three is the largest, the other two may be equal or of different sizes, but all must be of the same general form.

**18.** The members of a group of three need not be of exactly the same form, though they should resemble each other sufficiently to give at first the mental impression that

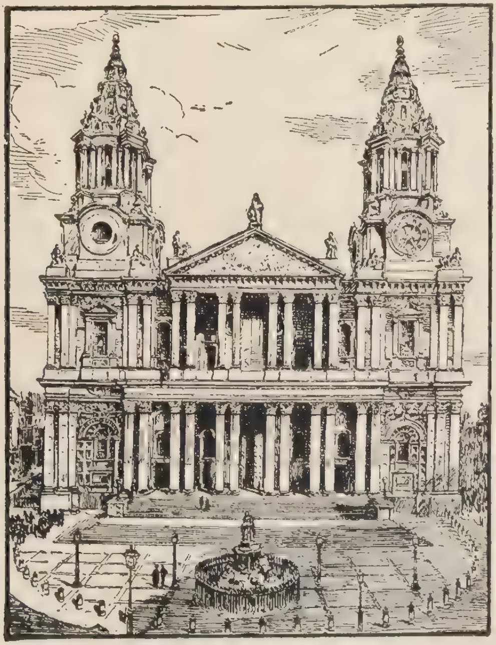


FIG. 8.

they are alike. Take for instance the towers and dome of St. Paul's Cathedral at London, Fig. 7. Here are seen the western towers and the central dome, utterly unlike in form and purpose. The dome, however, so takes up the mind that the towers are not considered until the dome has made its full impression. The towers therefore become a subordinate feature in the roof treatment, while the dome dominates everything around it. In the western facade, Fig. 8, taken alone, however, the towers are the principal features, taken as a group of two, with the two-story porch between as a connecting link.

**19.** Now, to sum up these rules for grouping, we have in Fig. 9, a group of one, at (*a*), showing the force and strength of an object which is designed to stand out by itself, independent of all surroundings.

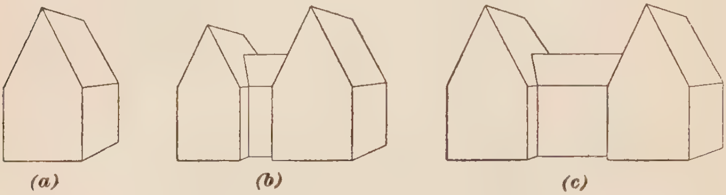

(a) (b) (c)

FIG. 9.

At (*b*) is shown a group of two unequal objects, connected by an insignificant link which serves only to unite the two members of the group. Here the attention is first arrested by the larger gable, and the mind then gradually relaxes and receives the impression of the whole mass as an object in *unity*.

Next we have, at (*c*), a group of two equal objects connected by a link which in this case must be more prominent than in the previous example. Where the group is of unequal objects, it is sometimes desirable to bring them close together in order that their inequality may be more pronounced. Especially is this the case when the difference in mass is not very great. When the objects are the same size, however, it is well to separate them somewhat, as there is no occasion to compare one with the other; and should there be a slight inequality, either of form or detail, the separation will assist in subduing it.

**20.** In a group of three we have the same rules to follow, though the problem is slightly more complex, and in some cases taxes the designer's ingenuity to a greater extent. At (*a*) in Fig. 10 is shown a group of three unequal objects; the largest one is in the center, the second one on the right, and the smallest one on the left. Now this is the most logical arrangement for this point of view. The greatest mass is in the center, where it should be; while the lesser object is nearer the eye, where it appears in its true size. The smallest object is the most distant where the effect of perspective is to make it contrast more strongly with the central object and at the same time remain subordinate to the secondary mass. If the smallest object were nearest the eye, the effect of the perspective might tend to make the two ends at first appear symmetrical, which closer study would afterwards prove to be false, and the repose of the composition would thereby be likely to become uncertain. Masses *1* and *3* should be placed somewhat closer together than *1* and *2*, as in order to establish a feeling of balance it is not well to have too much material on either side of the center line. If circumstances compel *1* and *2* to be close together, then balance may be preserved by carrying *3* still farther away and emphasizing the lack of symmetry instead of trying to hide it. Under such circumstances, however, it is usually better to assemble *1* and *2* as a single mass and treat the entire composition as a group of two. If the group is to be viewed from both the left and the right, so that either the smallest or the second mass is nearest the eye, then the

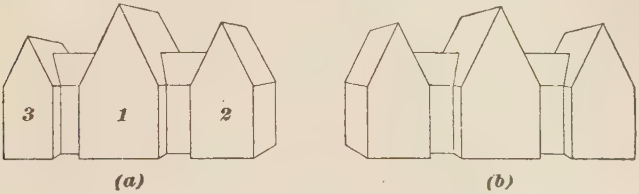


FIG. 10.

balance may be maintained by keeping *3* and *1* closer together than *1* and *2*, thus emphasizing the diminutiveness of *3* without affecting the size of *2*, except by perspective.

The group (*b*) shows a symmetrical group of three with the masses equally spaced and the largest object in the center. This is an imperative arrangement for such a group, and any deviation is likely to throw it out of balance.

**21.** Equal but dissimilar objects should never be grouped. In Fig. 11 at (*a*) is shown a group of two dissimilar schemes of roof treatment. The effect is very unpleasant, as there is much uncertainty as to which detail is the more important. If they were alike, there would be no such feeling, as the one would possess as much value in the composition as the other, and they would harmonize; but as it is they stand in competition, thereby destroying not only harmony and repose, but also balance and symmetry. At (*b*) is shown a group of three equal and dissimilar objects, and though the effect is not as bad as in the previous case, it is a combination to be avoided, as it can never be made to yield satisfactory results.

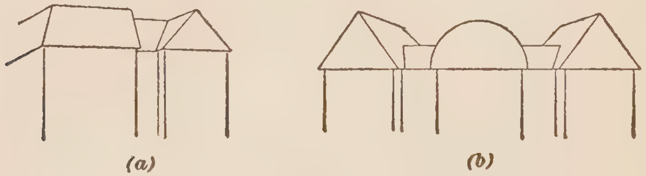

(*a*) (*b*)

FIG. 11.

**22.** This leads us to a scheme of design which may be termed *double composition.* This may be described as that character of composition which joins in one design two dissimilar objects which are not pleasing. One of the worst forms of double composition is that of a pair of arches whose outer abutments rest on masonry walls, and whose joint inner abutments are supported by a single column. In any group of three members, the central one must be made much the largest, if it differs in shape from the other two. Many prominent buildings are designed with a small central detail, flanked by large masses quite different in character. Such compositions, to be successful, must have the flanking masses so large that it is evident that a group of two, and not of three, is intended.

**23.** A group of four or more members is never satisfactory, and where there are more than three principal objects in a composition, they should be assembled in minor groups of from one to three details, and so treated that the general effect is of a group of two or three.

Fig. 12 illustrates this scheme of composition. Masses *3* and *4* are assembled to form a minor group which balances group *2* on the opposite side of the predominating mass in the middle. In this manner almost any number of objects may be harmonized in an apparently double or triple group; and the designer thus has before him an object towards which he can systematically work, and a definite idea of the theoretical requirements which his problem in design demands shall be fulfilled. This is the proper method to secure satisfactory results in double grouping, and it should be borne well in mind that, whether the objects are equal or unequal, the members in each group must always be alike. In triple grouping, the central member must be much the largest, or the three members of the group must be alike; and finally, in any group of many members, one should be much the largest, and the others must fall together in subordinate groups of two or three.

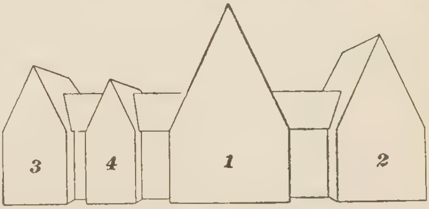


FIG. 12.

## INTERIOR ARRANGEMENT.

**24.** While composing the design of a building, and while studying each part of the plan, the possibilities of the resulting whole must be kept vividly in mind. The plan itself must not absorb all of our attention, but must be considered as a mere incident of the whole design. It is simply a horizontal section of the building, and bears to the entire structure a relation no more important than the longitudinal or transverse section; it is, however, the source of much comfort or discomfort to the occupants of the building, and the general adjustment and arrangement of the apartments should be primarily and at all times governed by considerations of convenience.

Too often the plan is given precedence in the matter of importance over all other sections, but a satisfactory whole can only be secured by duly studying each and every section which pertains to the composition. Considered as a working drawing, the plan is indispensable, the vertical sections being of secondary importance; but that is no reason why the latter should be relegated to an inferior place as objects of serious study in the composition, while the plan itself monopolizes all the thought and ingenuity at the designer's command. Too frequently the plan and the visible portions of the structure erected upon it are studied separately and independently. The exterior is fitted to the plan as best it may be, instead of growing out of it as a natural result. By having our thoughts led away from the plan to the building itself, we shall be less likely to start designs which do not work up well, and, instead of having to fit our elevations to our plans, we will find them growing out naturally and easily, because, while studying the plan, we have been mentally evolving the whole.

The successful design is produced only when the plans, elevations, and vertical sections are carried along together, and when the preliminary design has been sketched in the mass, and all details have been left for subsequent elaboration. Then, when the preliminary block plan, elevation, and section are determined, the large-scale studies may be started; and, as before, they should be carried on together, so that the consequences of any change in one may be readily noted in each of the others.

Constant tracing and retracing of every part of the design, in order to study the effect of every possible modification of it upon each other part and upon the whole, is the rule of practice in the offices of all the best architects.

**25.** The plan has a number of predetermined dimensions, such as the thickness of the walls and the size and grouping of the piers; it is also, more than any other section, affected by considerations of use and convenience; the relative position, size, disposition, and arrangement of rooms, halls, stairs, fireplaces, etc. must be determined in the plan; but it is as great as it is a common mistake to imagine that only convenience and utility are to be here considered; for the artistic value of every structure depends, or should depend, as much upon its plan as upon its elevation. This will be readily seen after starting the sketch plans and elevations, especially if we make frequent sketches in perspective of interior as well as exterior arrangements. Thus, we can keep before us the relative proportion of all the rooms and apartments, and we must keep that proportion in mind throughout all our sections and elevations, for the changing of the height of the ceiling in a room makes a vast difference, and we must, if possible, ascertain the relations desirable between all three dimensions of every important room. The greater its importance, the more careful the study required. While we are proportioning the length to the breadth, we must bear in mind the proposed height of the room, in order not to have it of awkward proportions; so that we see now that it is in the designing of the plan that all of these have to be considered. In order to change the apparent dimensions of a room, we may introduce *pilasters*, and these must be shown in the plan, as they will have a great influence in the spacing of doors and windows. Or we may have to change the actual dimensions, and so start a series of alterations that may revolutionize the whole plan. Not only do the proportions and actual size of each room require careful study from the esthetic point of view, with the constant exercise of the pictorial imagination, but the very shapes, positions. and sizes of the rooms, relatively to each other, must be subjects of design.

**26.** Another question of esthetics is that of the *sequence of forms.* Nothing is more wearisome or monotonous than a series of rooms all of the same size or shape. Variety is indispensable to artistic excellence, and the arrangement and succession of rooms of different forms and proportions is a very important element in producing emotions of pleasure, whether the structure is a cottage or a club house, a mansion or a museum; while in strictly monumental work of a religious or civic character, the proper succession of aisles, chapels, and bays, or of reception rooms, parlors, and vestibules, taxes the highest artistic resources of the designer. A most interesting example of this is the Borghese Palace, at Rome, where, owing to the angular direction of the two streets on which the palace is built, the rooms are a succession of trapezoidal apartments, diminishing towards the narrow end of the building until the last room is scarcely more than a closet. The necessarily irregular shape of the rooms is responsible for their awkwardness and lack of dignity. But the character of the structure is rescued by the skill of the architect in drawing an axis through the whole range from end to end, upon which a broad door opens into each successive room, and the long vista produces an air of grandeur that entirely redeems the insignificance of the trapezoidal forms. The Hotel du Maine, at Paris, Fig. 13, is another good example of the wise use of axial lines in laying out a plan, as well as a proper consideration of the necessity of a pleasing variety and sequence of forms.

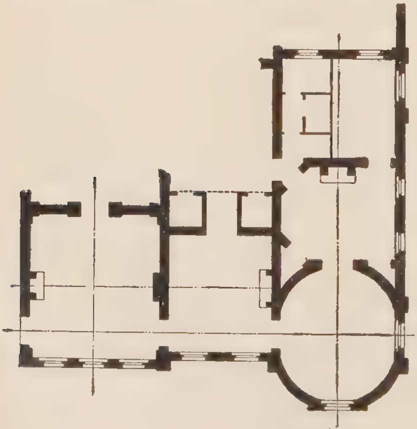


Fig. 13.

**27.** First of all, a positive excellence to be aimed at in all planning is *simplicity.* Complication and irregularity of plan are not evidences of ingenuity, but the reverse. It requires the highest art and skill to perfectly satisfy all the complex needs of an important building, by a plan that appears to the eye, on paper, to be laid out on the simplest and most obvious lines, free from artifices and makeshifts, all parts fitting perfectly into each other in simple and orderly combination.

It is to be noticed that the best arranged and most orderly plans, and those most productive of powerful effect in execution, are precisely those which on paper appear the simplest.

Observe the plans of such widely differing structures, erected at such widely separated ages, as the Parthenon (see Fig. 18, *History of Architecture*); Hagia Sophia, Fig. 43; the medieval cathedrals, Fig. 76; and the Renaissance palaces, Fig. 116. The simplicity of the scheme by which such varied and complex parts are combined, will immediately command attention.

**28.** Another excellence, to be obtained if possible in every plan, is *symmetry*. This term in design has sometimes been understood to mean that one-half of the plan should be the exact counterpart of the other half, and that to this requirement every other must be subdued. This definition, however, relates only to axial symmetry, and explains only a portion of the value of the term.

The approach to such symmetry, both externally and internally, is pleasing and satisfactory; while the absence of it, unless compensated either by very skilful *balance* in the design or by the independent symmetry of each portion of the mass constituting the whole, is invariably unpleasing and disappointing.

Upon the Acropolis at Athens (Fig. 29, *History of Architecture*) stand two most conspicuous examples of symmetry: the Parthenon, whose four elevations are all symmetrical, and the Erechtheum, which is composed of three parts, differing in design, level, and dimension, but with each of the three perfectly symmetrical in itself, and so appropriately placed as to compensate entirely for the lack of the geometrical symmetry of the mass.

Where symmetry is impossible, balance may be practicable. That is, one feature of a plan or an elevation may be balanced, not by an exact counterpart on the other side of the central axis, but by another feature of equal importance though of entirely different form. For instance, in a monumental hall, a staircase may occupy one side and be balanced on the other side by a handsome group of statuary. And then again, when neither symmetry nor balance can be attained, it is generally desirable to emphasize the unsymmetry and establish a balance on some other axis of the plan.

**29.** This subject of *axes* is of much more importance than is generally supposed. We are more familiar with their importance in the elevation where the placing of one part above the axial line of another, or the balancing of the window openings on each side of the doorway is generally desirable, but we do not as a rule give it proper attention in the plan. The distinguishing characteristic of many American dwelling houses is the irregularity of their plans, and although this sometimes leads to picturesque effects, it is by no means a result to which good planning should be sacrificed. Many a plan from which geometrical symmetry and balance are wanting, acquires dignity and a certain air of fitness and order from the proper use of axes in laying out certain features in the arrangement.

**30.** Before considering further the details in the arrangement of plans, let us be clear in our understanding of the meaning of what is called a *monumental plan*. This term is not applied to monuments alone, nor even to buildings that are intended to be monumental in size or purpose; nor yet because the plan of a building covers a large area. A monumental plan is one that produces no impression of restraint or limitation in any part. Largeness of parts, simplicity of arrangement, and general outline, and combinations that make most of the space and dimensions available, produce the monumental effect. Nothing can well be imagined more monumental than the Pantheon at Rome (see Fig. 32, *History of Architecture*), while a plan such as shown in Fig. 14, which is cut up into many small parts, complicated by many corners, nooks, and recesses, conveys an impression which is anything but monumental in its nature. Moreover, it is not sufficient that the larger and more important divisions of the plan shall be made spacious and impressive; the entrances, approaches, stairways, and halls are nearly as important. These the public throng most, and if first impressions count

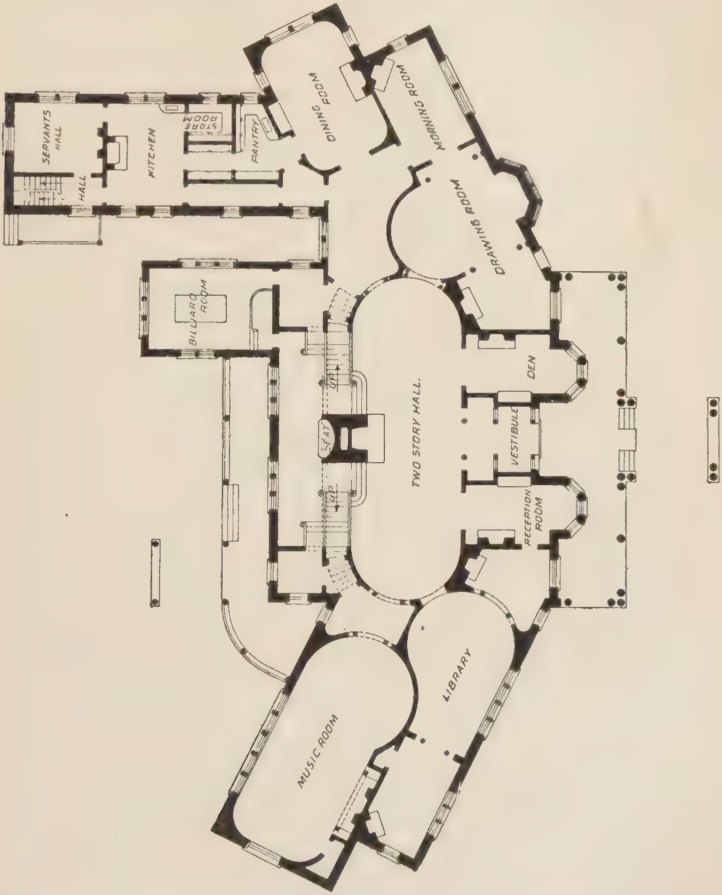


FIG. 14.

for anything, it is important that these features shall appear generously conceived and liberal in their dimensions. The different impressions felt on entering French and English cathedrals are largely due to the superior size, depth, and grandeur of the French cathedral porches, compared with the trivial openings that admit one to the English churches.

The portico of the Roman Pantheon is a fit introduction to the majesty of its interior. The great narthex of Hagia Sophia is a worthy vestibule to the greater splendor and loftier beauty of the Byzantine dome. These considerations apply not only to public buildings, but also to those private buildings which aim at amplitude and dignity, rather than coziness and seclusion.

The public buildings of Europe show that great care and study has been bestowed upon these distinctive features; a generous allowance of space has been assigned to them that is too sadly wanting in buildings of the same class in America. There are, however, a few notable exceptions, but they exist mostly in hotels and apartment houses, and not in the municipal or government buildings. Throughout France there is hardly a town that does not possess one or more buildings that would put to shame, by the dignity and impressiveness of their entrances and stairways, many of the most pretentious public buildings in America.

No innovation in American domestic architecture has created such a favorable impression, as a feature in house planning, as the modern idea of converting the entrance hall into a reception room, with wide, elegant stairs, plenty of space, and cheerful furnishings, instead of the narrow tunnel-like passageway, half blocked by a narrower stairway (constituting an apartment suggestive of little welcome to the visitor), which we witness in many of the houses erected a generation ago. But it certainly would be inconsistent to give the hall and stairway the sole benefit of our resources in ingenuity of arrangement and design, leaving the principal rooms and main features of the plan simply rectangular. A room which is merely a square box can never be monumental, whatever may be its size, and what can be done to make it so depends entirely on the merits of the case.

The proper grouping and arrangement of the doors and windows will produce the desired effect in one case, while, under other circumstances, pilasters, ceiling beams and cornices, and niches arranged in the walls, will impart a richness and dignity to the bare rectangle; or the bare walls may be left for frescoes or painted decorations, of whose character we need not concern ourselves, while scheming out the plan.

The modern resources of iron beams, stud partitions, and hollow brick, tempt us to design the upper stories independent of those immediately below, and to arrange rooms and to place partitions as seems to be most convenient, without regard to those in adjacent stories. Such a course, however, cannot be too strongly condemned; being structurally defective, no satisfactory results can ensue, while skilful adjustment, which constitutes the art of planning, is at once evinced by successfully harmonizing the requirements of the different stories in such a manner that the principal divisions shall be the same throughout, and thus be constructed as continuous partitions, while the subdivisions formed by partitions which are not continuous shall be as few as possible.

This is of great importance for other reasons than that of stability; pipes, flues, wiring tubes, etc. are run from one floor to another through the heart of the partitions, and unless the partitions are placed immediately one over another, undesirable offsets are formed in the pipe or flue lines, which materially reduce their efficiency.

## EXTERIOR TREATMENT.

**31.** If the plans have been studied with constant regard to the resulting whole, the form of the exterior will be already determined in some of its broadest features, before a line of the elevations has been drawn. The width and depth of all the projections and wings, the general arrangement of the wall openings, and to a certain extent the form of the roof, are already determined provisionally by the arrangement of the plan. They are the first limitations that govern the exterior design; limitations that may be modified, however, but always at a cost of a change in plan. And yet such changes in plan *must* be frequently made in order to arrive at the best solution of the problem under consideration. Patience, perseverance, and courage to constantly alter and realter different parts of the design that may be unsatisfactory, are attributes of the character of the true architect who is successful in his works. In designing, we must always be ready to retrace every step again and again until the result fulfils the complete limit of our requirements. The resources at our command that contribute to the expression of artistic taste in our designs, are: (1) *Outline of mass;* (2) *proportion of parts;* (3) *distribution of voids and solids;* (4) *light and shade;* (5) *ornament and color.* The demands of beauty require graceful and elegant forms well suited to the purpose for which they are intended, and appropriately expressive of the reason for their existence. In a perfect building, all of these resources are made use of, and are so arranged, adjusted, and blended that each and every detail harmonizes with each and every other detail, as well as with the whole composition of which they form a part, and its character betokens a repose which can only be secured when reason and beauty are in unison.

If we carefully examine the famous buildings of all ages, we will discover that these resources range in importance practically in the order above given.

**32.** The fundamental beauty of a noble building—the mental picture of it which we carry with us—is the outline of its mass. The beauty of this outline appeals to us alike in the Parthenon at Athens, the Pantheon at Paris, or St. Paul's in London, and is totally independent of the decoration of these structures. If the modeling of the masses which enter into the composition has been well proportioned, we will invariably carry a pleasant memory of the beauty of a building in our mind, even though the decoration and detail is incongruous and inappropriate.

Light and shadow impart dignity or variety to a composition. They are a most powerful means of producing beauty, yet they are wasted if the structure has not been carefully modeled and its parts duly balanced. Many very beautiful buildings present a large area to the light without having a single shadow of importance, while others, equally beautiful, derive their beauty very largely from the play of light and shadow over their breaks and cornices.

The Strozzi Palace (Fig. 89, *History of Architecture*) is an example of the former class, its entire facade being unbroken by any prominent projections except the cornice surmounting the whole. This building depends for its architectural effect upon the dignity of its mass; the insignificant shadows cast by the projections of its ashlar, and by the recession of its windows, being scarcely noticeable in the broad expanse of the front. The heavy projecting cornice was here necessary to contrast the simplicity of the front. Had it been designed with less boldness, it would have suggested simply a horizontal belt course on a partly finished building, and it was, therefore, necessary to emphasize its projection beyond the possibility of mistaking it for anything else than the overhang of the roof. The Strozzi is one of the noblest palaces in Italy, and is worthy of close study on account of the simplicity with which this grandeur is obtained. In contrast to this are the structures of the early French Renaissance (see Figs. 98 and 99, *History of Architecture*), dependent for their beauty entirely upon the varied play of light and shadow of the numerous projections and pinnacles scattered through their composition.

The distribution, form, size, and grouping of the voids and solids is equally important, and is somewhat related to light and shade by interspersing small areas of darkness amid the brightness of the illuminated areas of wall surface. By them and their arrangement, whatever the proportions, the whole building is made monotonous or varied in its composition.

According to this distribution of voids and solids, and the arrangement of its high lights and shadows, the structure becomes graceful, dignified, light, and winning, like the chateaux along the Loire (see Figs. 98 and 99, *History of Architecture*), or stern and strong, like the Palazzo Vecchio, in Florence, shown in Fig. 80, *History of Architecture.*

**33.** Ornament should be used as an adornment to what is already beautiful, as it can benefit an ignoble building only by drawing attention away from the glaring faults of the building itself. All the resources of design we have so far considered concern the form of either the various parts of a building or the entire structure; but now we reach the lowest kind of architectural beauty—that of *color*—color, the element in which the entire animal creation, the savage, and the infant rejoice, though blind to all other beauty in art.

Color, nevertheless, is the most sublime and widely diffused phase of beauty in the whole natural creation, the loveliness of nature seeming to depend on it even more than on form. But no splendor of color can impart other than a superficial and wholly meretricious sort of beauty to mean and unbeautiful architecture. It may be used to enhance it, but must always be subordinate to the artistic resources mentioned above.

**34.** The order of importance of the *elements of beauty* in *external* architecture is the reverse of their obviousness. The more subtle and refined these elements of beauty are, the more difficult they are to discern and understand—the less apparent and obvious they become to the senses.

The beauty of the Parthenon (Fig. 20, *History of Architecture*) is of a type far higher than that of the Paris Opera House (Fig. 129, *History of Architecture*); but the splendor and elaborate decoration of the latter attracts the attention and captivates the minds of those incapable of appreciating the exquisite refinement of line and proportion in the Attic temple.

Popular taste delights far more in extravagant and excessive detail than it does in noble proportions and refinement of outline, but even the uneducated tourist will carry a clearer and more accurate conception of the beauties of the Grecian temple than he will of the Milan Cathedral, because the beauties of the former are those of proportion, and because its every part is full of that higher beauty of refinement which does not reveal itself at once and cannot be fathomed by a casual observance. The tendency of the present age requires us to dwell upon these truths, to emphasize the value of the principles which produce them, which are so easily forgotten in the vulgar rage for bric-à-brac and detail, and to impress the fact that architectural beauty is in the form of the whole mass, and if the mass is not well proportioned and refined in outline, all the detail in the world will not make it a pleasing building. There are today a hundred good designers of detail and ornament to one who can compose a good elevation or lay out a rational plan.

In the streets of our great cities are hundreds of buildings whose details and ornaments are excellent; but few municipal communities can boast a dozen edifices that possess these higher attributes of beautiful outline and perfect proportion.

In ordinary street architecture there is much less scope for the study of mass than in detached monumental buildings, but elegance of proportion is no less important to secure. When one is hampered by the restrictions of a 25-foot lot for a seven-story building, the problem is a difficult one, but by no means hopeless. Well placed string-courses throughout the height, the emphasizing of just the right amount of horizontal members, the grouping and proportioning of windows so as to give the greatest amount of breadth and dignity to the whole, are all resources to be utilized by the true artist, but which are sure of misuse by any designer destitute of a keen sense of proportion. By breadth and dignity is meant that quality in a design which causes the eye to gather in the entire general effect of the building, and not be arrested by the prominence of some particular detail or projection.

**35.** There are few works of architecture in which the beauty of the structure is so entirely embodied in their correct proportions, apart from any detail or decoration, as the palaces of the Roman Renaissance. Here, too, the charm of picturesque variety and strong shadow is also advantageously displayed. The palaces of Florence and Sienna are, most of them, too sombre and fortress-like; while those of Genoa are, many of them, lacking in correct proportions and distribution of parts. But the buildings of Rome, of the Renaissance period, charm one with the mere grace of proportion and distribution.

With a few columns and pilasters, or a simple cornice, and two or three well placed belt courses, with windows well devised, and elegantly spaced, in stories whose heights have evidently been most carefully studied and proportioned, without carving or ornament, without a break in the flatness of the front wall, these palaces are beautiful, and one never tires of looking at them. This same noble quality is found in all good architecture, but is too often hidden more or less by richness of ornament and extreme variety of light and shade, which appeal to the senses more quickly than does excellence of proportion, and often receives credit for the architectural beauty which in reality lies behind them in the proportion and mass of the building itself.

The Farnese Palace (Fig. 94, *History of Architecture*) is a fair example of the value of the qualities above referred to. The entire facade is made pleasing and restful, simply by the refined proportion of its parts and the simplicity of the design.

The same may be said of an entirely different structure, the Palace Contarini, in Venice (Fig. 83, *History of Architecture*). It is a narrow facade with but three windows in each story; aside from its beautifully carved balconies, it is full of suggestions to modern house designers, on account of the fine proportions of the facade, and the skill with which the openings are managed.

Sometimes, the best way of producing nobility of effect is to emphasize some one dimension, especially where a too delicate adjustment of the three principal dimensions would tend to belittle a really good design. The architects of the

French cathedrals produced majesty by the great height of the nave, while the English designers secured the same effect by making the nave of great length; and both examples, by the grandeur of their results, show the value of such accentuation of one dimension while keeping the other two within moderate limits. The architects of the great Greek temples, exaggerating neither one over the other dimension, produced a beauty of the most perfect type by the harmony of all three.

Which of these courses to follow, every architect must choose for himself, but the decision must not be determined by chance, but must be the result of mature consideration.

**36.** Next to proportion comes light and shade, and, also, the distribution of voids and solids, which may be made to minister to fine proportion or be its ruin. These concern the features of the building. They determine the use and arrangement of cornices, entablatures, string-courses and moldings, projections and recessions, piers, columns, pilasters, doors, windows, and loggias (or covered external galleries, especially in upper stories).

The fact that many of these features are largely conditioned by the plan, only makes it more imperative to study the plan with the resulting elevations constantly in the mind's eye, and to keep its final form in suspense until the requirements of the exterior are fully determined. Thus only can the projections, balconies, loggias, doors, windows, etc. be so distributed as to produce on the exterior the desired effect. The Gothic builders understood this, and depending on light and shade for architectural effect, their plans are so designed as to make these effects possible. The exteriors of medieval buildings, both secular and religious, are full of movement and variety. They sparkle with the play of light and shadow in vertical lines, cast by buttresses, piers, and pinnacles, and the shaft jambs of the tall windows. To give them greater animation, crockets and finials were introduced, catching the light in brilliant points and casting fanciful and serrated shadows, while tall pinnacles outline themselves against the dark roofs of slate or copper.

In Classic and Renaissance buildings the vertical shadows are few or slight, and the strong horizontal shadows of cornices and string-courses predominate. The openings are fewer, but are wider and larger, and broad areas of solid wall give majesty and repose to the whole conception.

**37.** From the preceding it will be seen that the great fundamental quality underlying all architectural structures is *proportion*—proportions of masses and proportions of details, and proportions of details to masses. Different architectural epochs had different systems of proportion, and each age was artistically a success or a failure directly as this system was positive or arbitrary. The Greeks had a system of proportion more refined than anything since discovered. It was based upon mathematical relations so subtle that the true secret of its workings has never been entirely elucidated. Nevertheless, every Grecian monument proclaims emphatically to the analytical student that each line of its mass and each detail of its composition is proportioned by a method as perfect as it is obscure.

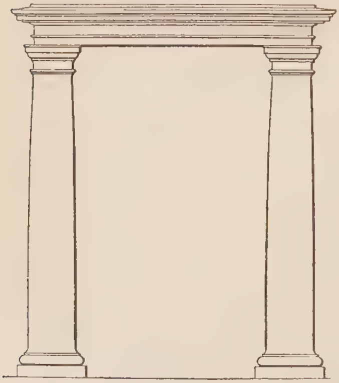


FIG. 15.

The Gothic builders had a system, based upon geometrical motives, and the grand cathedrals of the thirteenth century stand today as monuments of its perfection. The Renaissance age had no fixed system of proportion peculiar to itself, but modeled its structures on the supposed system of the ancients; we consequently see a varied lot of edifices scattered over Europe, which, beautiful though many of them are, stand more as monuments of lack of comprehension of the purpose of classic forms than of appreciation of the value of a perfect system of proportion.

It is, therefore, necessary that the architectural student should familiarize himself with the idea of proportion from the very beginning of his studies, and every drawing he makes should leave with him some permanent mental impression of the proportion of its parts to its whole.

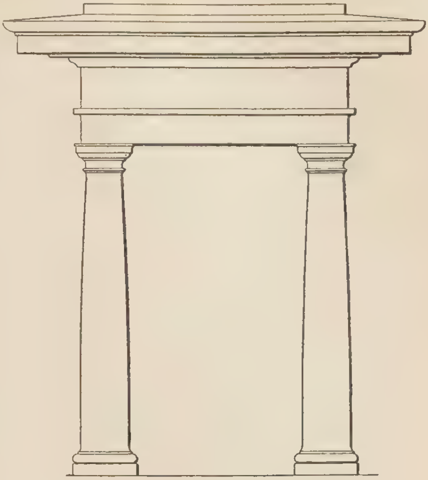


FIG. 16.

**38.** No absolute rules can be laid down which will govern all cases of proportion. Practice, experience, and inherent good taste are the only means of securing the most desirable relations between the different parts of a building. A glance at Fig. 15 is sufficient for one to discover that the entablature is far too small and light for the columns supporting it, and looks pinched and ridiculous. Fig. 16, on the contrary, shows a pair of columns carrying an enormously heavy entablature, as much too large as that in Fig. 15 is too small.

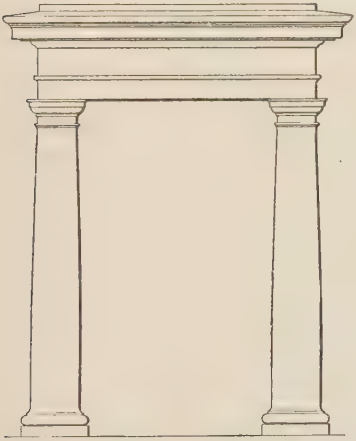


FIG. 17.

These errors of proportion are appreciable to the eye, and in no way require mechanical measurement to verify them. It is, therefore, evident that a well proportioned entablature will be considerably larger than that in Fig. 15, and much smaller than that shown in Fig. 16, and if the eye is well trained it will discover the proper proportions in Fig. 17.

The nearer we approach the exactness shown in Fig. 17, the more difficult and delicate is the task of discovering unaided by mechanical measurements any discrepancy in proportion; but by practice and experience the eye will become so trained that it will discern these discrepancies at a glance, and in composing an architectural design the judgment of the trained eye is worth all the mathematics ever invented. However, in order to acquire this training, we must study such architectural forms as will permit a mathematical analysis from this standpoint.

## CLASSIC STANDARDS OF PROPORTION.

### THE FIVE ORDERS OF ARCHITECTURE.

**39.** The orders, heretofore so frequently referred to, furnish us with a standard of proportion with which we can measure all the classic monuments, and by which the work of the Renaissance was, and much of the modern architecture is still proportioned.

As we have already seen, the structures of the classic ages were nearly all columnar—either with lintels connecting the tops of the columns as the Greeks built, or with arches, according to the Roman custom. Now, the architects of the classic ages had reduced to an exact *system* the proportions of length to thickness in columnar work, and down to the present day we have been unable to improve on their proportions, and have followed them as closely as did their admirers of the Renaissance period. This system is universally known as the "Five Orders of Architecture," and it embraces every combination of lines and masses seen in the classic monuments.

In it we find the fundamental principles of proportion, and only by the most careful study of these principles can we advance in our studies of architecture as a fine art.

**40.** In its architectural meaning the term **order** refers to the system of columniation practised by the Greeks and

Romans, and is employed to denote the column and entablature together—that is to say, the upright supporting piers, and the horizontal roof beams or *trabeation* supported by them. These two divisions constitute an order, and so far all orders are alike; but the form and proportions of the subdivisions of both the column and the entablature, make it necessary to divide the original Greek orders into three classes, and when these three were adopted by the Romans, they again divided two of them, making five in all. Hence, it has become proper to refer to the *Five Orders of Architecture*, including the entire list. The three original orders of the Greeks are the Doric, Ionic, and Corinthian, as explained in *History of Architecture*. Each order is an assemblage of parts subject to uniform, established proportions, and is regulated by the office each part has to perform. This so called "assemblage of parts" refers to the base, shaft, capital, architrave, frieze, etc., while the "uniform, established proportions" are the comparative sizes of these parts to each other in the same order. "The office each part has to perform" governs its size, shape, and position, and thus completes the expression of character in the order.

**41.** The general character of the Grecian-Doric order is expressive of grandeur, dignity, and simplicity. Hence, we find it used almost exclusively in such temples as are dedicated to the most revered of the Grecian deities, such as the Temple of Zeus, at Ægina, and the Parthenon, at Athens. This is the most ancient of all the classic orders, and the proportions of its parts vary considerably in the different periods of its history. However, it reached the zenith of its perfection in the Parthenon, and it is from the portico of that temple we take the example illustrated in drawing plate entitled, Grecian Doric, in *Advanced Architectural Drawing*. It has already been observed that the Grecian-Doric column consists only of the shaft *B* and the capital *C*, which latter is composed merely of an *echinus* and an *abacus;* the first being a convex molding spreading out from the top of the column beneath the other member, which, though being a very important one, is no more than a plain square slab upon which the architrave *D* rests. The Grecian-Doric order never possesses a base, but stands upon a stylobate *A*, which is the substructure or foundation usually disposed in three steps or divisions that extend entirely around the building, and by spreading the ground line of the structure give a proper feeling of solidity and support. In the outline of the column we first observe contraction and then expansion; the former where the echinus converges to the neck of the column, and the latter where the column swells out to form a firm and substantial support at the bottom which is larger than the top. With few exceptions, the column of the Grecian-Doric order is fluted; that is, its surface is grooved perpendicularly by a series of concave channels which touch each other and form a series of ridges, or *arrises*, upon its surface—a mode of decoration which is the direct opposite of that practised by the Egyptians, some of whose columns exhibit, not channels, but a series of convex shafts like a bunch of reeds or stems bound together. In the Doric order, the number of channels is either sixteen or twenty, and in the other orders there are usually twenty-four, and though the number varies, it is invariably divisible by four. The reason for this is to be found in the probable evolution of round columns from square piers, as explained in *History of Architecture.*

Doric flutings are much broader and shallower than those of the Ionic or Corinthian orders—broader for two reasons: first, because they are fewer in number, and, therefore, divide the circumference into larger parts; and, second, because there are no separating fillets between them. The shallowness of the Doric flutes is due to the fact that the arrises, or edges where the flutes come together, would be thin and liable to breakage if the flutes were deeply cut. This manner of fluting Doric columns, leaving arrises between the grooves instead of fillets, has been retained in modern practice as one of the characteristics of the order. In the Grecian Doric, every detail is marked by its breadth or flatness, or by its sharpness. There are no curved moldings or surfaces except the *epitithedas*, a term given to the uppermost member of the corona and the echinus, the latter being almost flat on its under side and finished with a sharp turn against the abacus. The breadth and shallowness of the channels, and the flat curves in which they are formed, are, therefore, in perfect keeping with the style, as are also the sharp arrises between the flutings, which are expressive of a severe simplicity. The horizontal rings, or *annulets*—mere grooves cut around the neck of the column to separate the capital from the shaft—are again expressive of the extremest simplicity, and are in direct contrast to the projecting astragal, or convex molding, of the Doric capital as modified by the Romans.

The echinus is a simple convex molding, from its shape often called a thumb molding. Its form is suggestive of strength as it expands to connect the diminished upper end of the column with the overhanging abacus.

**42.** The entablature of the Doric order is, like the column, the embodiment of dignity and simplicity. Its lowest division, the *architrave D*, is a plain beam, whose height including the tænia, or fillet, is a trifle less than the upper diameter of the column. The middle division, or *frieze E*, constitutes a very characteristic feature of the Doric order, being invariably ornamented with its *triglyphs* and *metopes*. The former of these consists of upright blocks about one-half the width of the mean diameter of the column, having their faces grooved with two **V**-shaped channels, and their edges chamfered off with two half channels, thus making three channels altogether, from which the ornament derives its name of triglyph, or three-channeled. A portion of the triglyph, called the fillet, extends below the tænia, and depending from it are six drops, or guttæ, which represent the heads of trenails or pins used in the early wood construction.

In regard to the arrangement of the triglyphs, one was placed over every column, and one or more over the space between each pair of columns, but always so spaced that the metopes, or spaces between the triglyphs, should be exactly square; in other words, the height of the triglyphs is equal to the distance between them. In the best Greek work there is only one triglyph between each pair of columns, and this arrangement is usually called *monotriglyphic*, or single-triglyphed intercolumniation. A peculiarity of the Grecian-Doric frieze is that the end triglyphs, instead of being, like the others, in the same axis, or central line, as the columns beneath, are placed quite up to the edge or outer angle of the frieze; this is accomplished by making the extreme intercolumniations less by one-half a triglyph than the intermediate ones, thereby imparting an expression of strength to the angles of the building.

The triglyphs are thus seen to govern the spacing of the columns, and as the spacing or intercolumniation governs the diameter, and the diameter governs the height, etc., we see that nearly all the proportions of a Doric temple can be traced from the size of its triglyph. There is one exception to this, however, and that is the little choragic monument of Thrasyllus, on the south slope of the Acropolis, at Athens. This monument has no triglyphs, but a series of wreaths ornament the frieze in their stead. The guttæ are nevertheless retained, but instead of being grouped at intervals, they are continued across

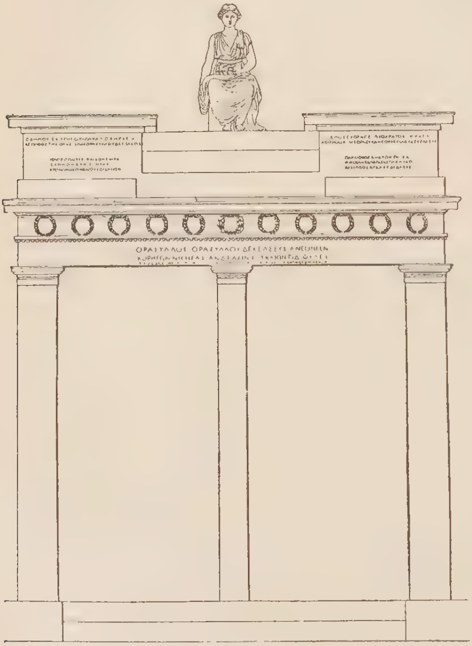


FIG. 18.

the lower side of the tænia uninterruptedly, as shown in Fig. 18.

**43.** The third and last division of the Doric entablature, the *cornice F*, though extremely simple, is strongly characteristic and boldly marked. It is in height about two-thirds the height of the frieze, and it is divided into three principal parts, the *corona*, with the *mutules* beneath it, and the *echinus* above it. The mutules are thin plates or tablets worked on the *soffit*, or under side, of the corona, directly over each triglyph and each metope. With the former they correspond in width, and their soffits, or under surfaces, are set with a *rake*, or slant, which makes them parallel with the line of the pediment. They represent the under side of the wood roof beams which extended over the eaves in the earlier construction. Three rows of *guttæ*, or drops, somewhat conical in shape, ornament the soffits of the mutules, and each row corresponds in number of drops with the guttæ on the triglyphs beneath. These guttæ are shown in the plan of the under side of the cornice, Fig. 5 of this plate, where three rows, with six drops in each row, are shown within the outlines of the plan of each mutule. Here, also, is seen a section through the triglyph at the angle, and the **V**-shaped channels are shown in the face of the triglyph.

The *corona* is merely a boldly projecting flat member not much deeper than the abacus of the capital, although examples exist where it is even less.

The uppermost member of the entablature, the *epitithedas*, is sometimes a *cymatium*, or *wavy* molding, convex below and concave above, or it is an echinus similar in profile to the echinus of the capital. The cornice is to the entablature what the capital is to the column, the crowning member of the composition, completing and ending it in a very artistic and pleasing manner. In Fig. 1 is shown a plan of the column at its base, where the flutes and arrises are more clearly defined. In Fig. 2 is an enlarged elevation of the capital of the Doric column, where the echinus is shown continued in a dotted line up into the abacus. The purpose of this, as well as the method used by the Grecian artists to form the contour of their moldings and other details, will be described further on when we enter into the discussion of classic moldings.

**44. Antæ.**—Pilasters, as well as columns, may be considered to belong to an order, and in modern practice are frequently substituted indifferently for columns, where the latter would be engaged or attached to a wall. In Grecian architecture, however, the antæ are never so employed. They are never placed consecutively or in series, but always as a facing at the end of a projecting wall, as shown in Fig. 17, *History of Architecture.* Although the antæ are used in company with columns, they differ widely from them, as the shafts are never diminished, and the capitals are in no way similar to the caps of the accompanying columns.

The capitals of the antæ, Fig. 19, are composed of one or more slightly projecting facias *a*, above which is a molded abacus *b*, supported on an irregular molding which is hollowed out below, to form in section what is known as a *bird's beak c*. Below this bird's beak are a number of projecting fillets *d*, similar to the annulets on the Doric column. In a portico *in antis*, the want of greater harmony between the antæ and the columns is compensated by the contrasts. Flatness of surface in the antæ is contrasted with rotundity in the columns, vertical lines are opposed to inclined ones, and uniformity in regard to light stands in comparison to the varied play of light and shade on the shafts of the columns.

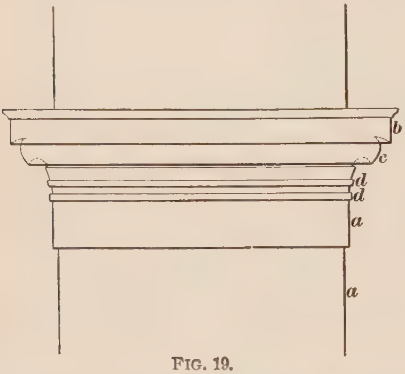


Fig. 19.

Instead of attempting to keep up a similarity between the shafts of the pilasters and the columns, the Greeks made a studied distinction between antæ and columns, not only as noted above, but carried still further, for they never fluted the faces of their antæ, whereas in modern practice both pilasters and columns are fluted, as will be explained hereafter.

**45.** The **Ionic order** is lighter and more delicate than the Doric, being expressive of grace and refinement rather than of grandeur and dignity. It was used by the Greeks in temples dedicated to deities representing the more earthly sentiments, such as the Temple of Victory, the Temple of Minerva Polias, etc.

Although the capital is the distinguishing characteristic, the character of every detail of the order differs entirely from the Doric. Besides having the addition of a base, the shaft is taller and of more slender proportions, and much less tapering. The example of the Ionic order shown in drawing plate entitled, Grecian Ionic, is taken from the porch of the Temple of Minerva Polias, and shows the order in the zenith of its perfection. The capital *D* is not only more complex, but also more irregular than the Doric capital, as it has two faces or fronts, parallel to the architrave above it, one of which is shown at *D*, and two narrower bolster sides beneath the architrave, of which one is shown in Fig. 3. This irregularity is considered by many a defect, which can be obviated only by turning the volutes diagonally, as in some Roman and modern examples, or by curving concavely the faces of the capital, instead of making them planes, thereby obtaining four equal faces, as is done in the capitals of the inner order of the Temple of Apollo, at Bassæ, Fig. 20. However, the Ionic capital, as used in the Erechtheum (see Figs. 22 to 26, *History of Architecture*), and in the Temple of Nike Apteros, or Wingless Victory (Fig. 27, *History of Architecture*), on the Acropolis, at Athens, suits its position as well, and is as perfect an architectural feature as is the Doric order in the Parthenon.

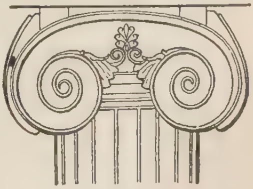


FIG. 20.

The only objection to the Ionic capital is that in the end columns of a portico it exhibits an offensive irregularity, because on the return side of the building the bolster shows itself beneath the face of the architrave; yet, even this is of no great consequence, unless the colonnade is continued down the sides of the building, and the capitals at the extremities present their bolster sides to the observer, while the intermediate ones show the voluted face. The Greeks, with their usual inventive ingenuity, gave the capital at the angle two adjoining voluted faces, so that it should agree with the other columns both on the front and on the flank of the building. This was accomplished by placing the volute at the angle diagonally, so as to obtain there two voluted surfaces placed immediately back to back, as shown in Fig. 21, which is an angle capital from an Ionic temple on the Ilissus River, near Athens. At *a* is the angle where the volutes are turned back to back, shown at *b* in the plan (*b*), and in Fig. 22 is shown a view of these two volutes as they would appear looking directly at the corner. We, therefore, have two volutes and two bolsters, as in any Ionic capital; but the volutes are on two adjacent sides *c*, *d*, Fig. 21, while the bolsters are on the two opposite adjacent sides *e*, *f*. A voluted face was thus kept to the outside on both sides of a corner, and the columns could be continued entirely around the cella.

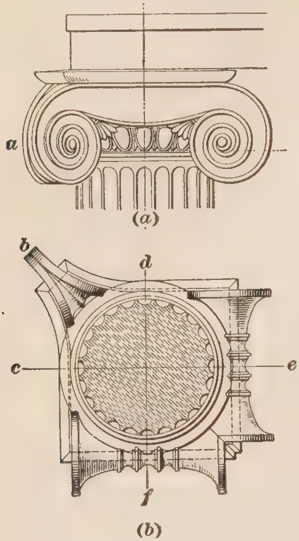


FIG. 21.

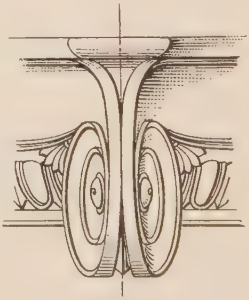


FIG. 22.

The Ionic order possesses a base which differs in outline and moldings according to the locality where the example is found. The best examples existed in Attica, the state of which Athens was the capital, and the most artistic base, and the one best adapted to the order, is found here, and is known as the *Attic base*, shown at *A* in the drawing plate. It consists of two heavy torus moldings separated by a scotia and resting on a square plinth, or stylobate. The upper torus is sometimes carved with a guilloche ornament, as shown, or is left perfectly plain, as explained under the chapter on moldings.

**46.** The shaft *C* of the column is grooved by twenty-four flutes, each pair of flutes being separated by a fillet. These flutes extend from the apophyge, at the base of the shaft, to the astragal at the neck. The neck is enriched with a carved honeysuckle ornament, which is carried entirely around the column. Above the neck is a fillet and bead, and above this is a small echinus, which is carved with an egg-and-dart ornament. Resting upon this echinus is a small torus which separates the echinus from the *pulvinated*, or cushion-like, capital, the ends of which are terminated by the *volutes*. A number of bands are run across the face of the cushion and rolled up on each side. The abacus is a flat slab whose molded edge is carved with an egg-and-dart ornament.

The Ionic entablature, as expressed in terms of the diameter of the column, is greater than that of the Doric order; but in proportion to the length of the column, the Ionic entablature is less than the Doric. For example, the entablature of the Parthenon is about two diameters high, while the Ionic entablature is about two and one-third diameters high; but two and one-third diameters of a column nine diameters high equal about one-quarter the height of the column, while two diameters of a column only five and one-half diameters high equal about one-third the height of the column, thereby making the Ionic order lighter and more delicate than its dignified brother, the Doric.

**47.** The Ionic architrave does not differ materially from that of the Doric. Its average height is equal to the upper diameter of the column, and it is usually divided into three surfaces, or courses, called *facias*, which very slightly project one over the other. There are a few examples where the architrave is left plain as in the Doric order, and in such cases the moldings are not so heavy as in this example from the Erechtheum. The Ionic frieze, being devoid of triglyphs and having no other characteristic member substituted for them, becomes a mere plain surface, interposed between the architrave and the cornice. This plainness may be relieved by carving thereon figures in bas-relief; but as sculpture of that kind does not belong to the character of the entablature, it is never taken into account in describing the details of the order. The Ionic cornice is a simple affair, especially in the Athenian examples, being merely a corona, with a cyma recta above it, and some narrow bed moldings beneath it. The soffit of the corona is hollowed out as shown by the dotted line, and the bed moldings above referred to are left when this soffit is so cut, and are here shown dotted under the corona. Between the corona and the cyma are two small enriched moldings, a bead, and another echinus.

This description completes the Grecian-Ionic order as seen on its voluted face; but as the order is not symmetrical on its four sides, further consideration must be given to its side views.

**48.** In Figs. 2, 3, 4, and 5, are given additional views of the capital and its details. Fig. 2 is a half plan of the under side looking upwards, and Fig. 3 is an elevation of the right-hand side. Figs. 4 and 5 are sections through the capital on the center axial lines shown at *a b* and *i j* of Fig. 2, the under side, or soffit, of the corona and cymatium, and Fig. 6 is a plan of the base *B*.

Returning to the composition of the front elevation of the capital *D*, we will first consider the neck of the shaft, and the fillet, echinus, and torus as being carried around the shaft in the same manner as the large echinus is carried around the Doric shaft. These three moldings are shown carried around the shaft in the plan as shown on the drawing plate at Fig. 2, and two of them are seen in the side elevation Fig. 3, and their profile in the section Fig. 4 is seen under the bolster.

If we now consider the volutes as being composed of a number of narrow bands laid loosely across the edge of the torus, and then rolled up where they project over the edge, we have a fair idea of their composition. In the plan Fig. 2, and the side elevation Fig. 3, the edges of these bands are shown with the bolster or roll between them. These two bolsters, one on each side of the capital, are grooved with seven flutes separated by fillets and beads, which are similar to the flutes in the shaft of the column, except that those in the column are semicircular in section, while those in the bolster are semielliptical.

In the section shown in Fig. 5, we have the profile of the moldings of the capital and the bands of the spiral as they would appear if cut through on the axial line *a b* of Fig. 1.

In the section shown at Fig. 4, we see the solid portion of the bolster as it would appear if cut through on the axial line *a b* of Fig. 3, and the fillets and beads carried around the bolster as shown, Fig. 2.

**49.** The **Grecian-Corinthian** order is the lightest and most delicate of the three, but it is almost impossible to determine for what class of buildings the Greeks considered it best adapted, as there is but one perfect example left for us to judge by at the present day, and that is the choragic monument of Lysicrates, at Athens, shown in Fig. 23. Like the Ionic, the principal characteristic of the Corinthian order is its capital—tall, bell shaped, and richly foliated, as shown at *C* in the drawing plate entitled, Grecian Corinthian. As was said with regard to the entablature of the Ionic order, the capital of the Corinthian column is higher in proportion to the diameter of the column than is either the Ionic or the Doric; but, as the shaft is longer and slenderer than either of the others, it is able to carry a higher capital.

**50.** The Corinthian capital has two rows of leaves, eight in the upper row, and sixteen in the lower row, so disposed that,

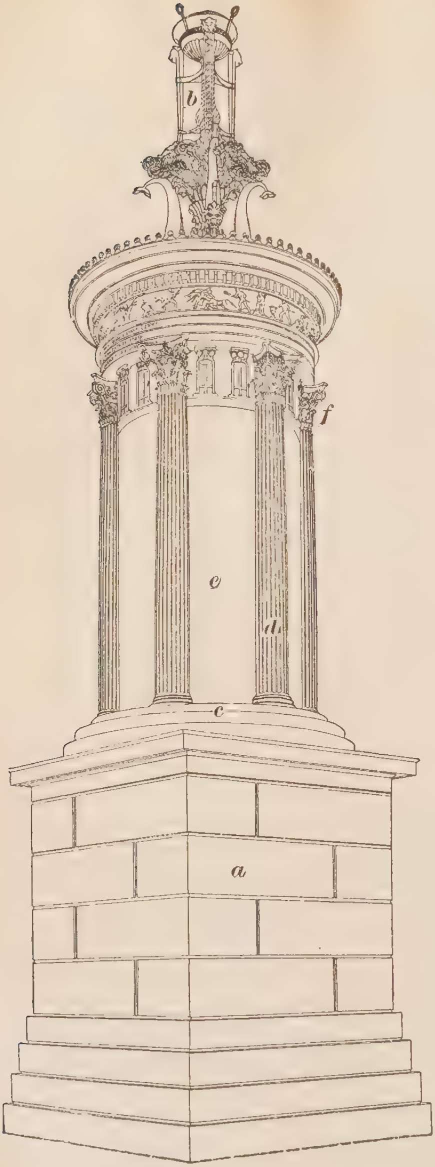


FIG. 23.

of the taller ones composing the upper row, one comes in the center beneath each face of the abacus, and the lower leaves alternate with the upper ones, coming both between and under the stems of the latter, so that in the first, or lower, tier of leaves there is, in the middle of each face, a leaf between each two leaves of the upper row, and also a leaf under the stem of the central leaf above them. Above these two rows is a third series of eight leaves, turned so as to support the small volutes, which in turn support the angles of the abacus. Besides these outer volutes, which are invariably turned diagonally, as in the four-faced Ionic capital, there are on each face of the capital two other smaller ones, termed *cauliculi*, which meet each other beneath a flower on the face of the abacus.

The abacus itself is different in shape from that of either of the other two orders. In the Doric it is, as we have seen, merely a thick slab resting on the echinus beneath it, and left absolutely plain; in the Ionic, also, it is square, but the sides are molded and sometimes carved, while the Corinthian abacus is, strictly speaking, not even square, except in general form. True, it has four equal sides, but instead of being straight, they are deeply concave in plan, and the acute point which would be formed by the meeting of these concave sides is usually cut off straight, thus making the abacus an eight-sided figure, four of whose sides are short and straight, while the other four are long and curved, as shown in Fig. 2. Thus, we see that the abacus here assumes a very different shape from its original one, yet merely to know this is to know very little; this form of it is, of course, a distinction, but it was not for the sake of distinction that it was adopted. It grew out of intention and purpose; it was dictated by necessity—or at least by artistic necessity, which insists that the abacus should be adjusted to conform to the upper part of the capital. Now, a square abacus would not suit a capital whose foliage spreads out so widely at the angles; so the Greeks curved the abacus to fit the capital, and overcame this difficulty as they had already overcome hundreds of others. This may to the student seem a very simple thing to do, and hardly worth his notice, but take into consideration the fact that these Greek artists had no rule or precept to follow, as we have today, that they had no authority to turn to and ask, "Is this right or wrong?" but had to rely upon their own judgment as to what best satisfied the eye from an esthetic point of view. The curvature of the cornice, the entasis of the column, the angular volute in the Ionic order, are all simple things in themselves; but as they appear suddenly in the history of architecture, without any similar form preceding or leading up to them, we must look upon them as inventions in art as important as they are apparently simple.

**51.** The base of the Grecian-Corinthian column *A* is of the Attic type, almost the same as that of the Ionic order;

and the shaft *B*, like the Ionic also, has twenty-four flutes separated by fillets, but these flutes and fillets terminate at the top very differently from the way they do in the Ionic. Here we have a row of leaf-like ends curling out from the column, with the fillets forming their central ribs. The edges of these leaves intersect in an angle, and this angle gradually flattens out until it disappears entirely in the surface of the flute. Above these leaf-like ends, and below the lower row of leaves in the capital, is a groove, cut entirely around the column, to emphasize the starting point of the capital, and which is said to have originally served as a receptacle for a braided band of bronze laurel leaves contrasting beautifully with the white marble of the monument.

The entablature is very similar to that of the Ionic order, with the exception of the cornice, which is larger and somewhat richer than the upper member in the order from the Erechtheum. The architrave is divided into three facias as in the previous order, but their surfaces are not perpendicular. On the contrary, the faces are battered back so that the three arrises, or edges, are perpendicular over one another, and the offsets are formed by the batter. The molding at the top of the architrave is a simple cyma reversa resting on a bead and surmounted by a rather heavy fillet. The *frieze* is shown here with the carved figures in relief as it appears in the original monument, although, as said before, this carving does not form a component part of the order itself. Above this frieze is a small *torus* and an ovolo supporting the dentil course. These dentils are small rectangular blocks, spaced about two-thirds their width apart, and in all probability are the stone representations of projecting ceiling joists, which existed in an early system of wooden construction. Dentils are also sometimes found in the Greek-Ionic entablature, but only in Asia Minor and other colonies, as the only example of a denticular cornice in an Attic-Ionic structure is that over the caryatid porch of the Erechtheum. This can scarcely be considered a satisfactory example, however, as the entire treatment of plan, elevation, and arrangement of the Erechtheum is entirely different from any other building in Attica; and, differing so materially in other points, it is not strange to find a dentil course over the caryatid porch, which is itself unique and might be considered a separate order.

Above this dentil course is a cyma recta, supporting a cyma-reversa bed molding under the corona. This corona projects more in the Corinthian than does the same member in the Ionic order; and the crowning member, instead of being a cyma as in the previous order, consists of a series of *antefixæ* supported upon a serrated band which is separated from the corona by a small echinus. In Fig. 6 is shown the under side of the entablature, taken on a line through the frieze *E*. In Figs. 2 and 3 are shown a plan of the under side, and a corner elevation, of the capital *C*. In Fig. 5 is a plan of the base *A* taken on a section line through the column, so as to show the depth of the flutings and the width of the fillets.

This completes the general description of the Grecian orders, a description that has been here given somewhat in detail, in order that the student may fully comprehend the liberties that were taken with these orders when the Romans converted them to their own uses.

**52.** The Five Orders of Architecture according to Vignola will now be analyzed and described, and the attention of the student is called particularly to the unrefining influence of the Romans as expressed in their interpretation of the Greek art forms.

In *History of Architecture* will be found the statement, "The Romans were not an imaginative race, and had few original ideas in architecture. Their early works were copied from the Etruscans, and their later efforts were borrowed from the Greeks." In nothing is this fact more evident than in the first of the five Roman orders, namely, the Tuscan.

**53.** The Tuscan order is but a modified form of the Grecian Doric, or, perhaps, more strictly speaking, it is an undeveloped form of the Roman Doric. It takes its name from the Etruscan people, who are supposed to be its originators, though it is not improbable that the Etruscans received their ideas from the same source as did the Dorians, both nations having emigrated from Asia, within two hundred years of each other. One thing is certainly true, the Tuscan column and entablature bear a closer resemblance to the proportions of the Greek Doric than they do to the Roman Doric, which was admitted to be more or less copied from it; and the Roman Doric resembles more the Tuscan column and entablature than it does the Grecian order, whose name it bears. Hence, we see that the Tuscan is a sort of connecting link between the Greek and the Roman orders. It contains many Greek details which the Roman Doric does not, while, on the other hand, the Roman Doric possesses many Tuscan features unheard of in the Greek. The characteristics of the order are its crudeness and plainness combined with its heavy moldings and lack of refinement in outline. It has, like all other Roman orders, a regularly proportioned and molded pedestal, which, though not a specific part of the order itself, is generally drawn with it when the order is shown alone.

**54.** In drawing plate entitled, **Tuscan Order**, the details are drawn out complete, with the exception of the shaft of the column, a portion of which is outlined in half elevation in Fig. 5. The pedestal is simply a square block *B*, with an apophyge, or escape to the fillet, resting on the plinth *A* at the bottom, and with a cyma reversa and a fillet at the top. Upon this stands the base of the column *D*, which consists of a torus and a fillet resting upon a square plinth. The capital *F* is in some respects similar to the Doric, but lacks both the refinement of the Grecian Doric and the delicacy of the Roman. It consists of an abacus, ovolo, and necking. The abacus is square in plan, and is composed of a fillet resting upon a plain facia which has an apophyge, or curved escape to the fillet. The ovolo is a plain molding often referred to as a quarter round, as its section is exactly a quarter of a circle. This ovolo of the column is circular in plan, as shown in Fig. 3—which is a plan of the under side of the column taken on the line *e f* —the ovolo and the fillet beneath it are simply a quarter round and a square offset, bent or worked around the neck of the column.

The entablature is subdivided into an architrave *G*, a frieze *H*, and a cornice *I*, in proportions nearer to the Grecian Doric than is the Roman order of that name. But the triglyphs and mutules characteristic of the Doric order are omitted entirely, while the moldings are large and heavy and out of proportion to the surfaces they are intended to ornament. The shaft of the Tuscan column is never fluted, and no carving or enrichment of its moldings or surfaces is ever practised. It has never been popular with modern architects, and the only example of any importance in modern work is the little church of St. Paul's, Covent Garden, London, by Inigo Jones. It was probably used here because it was cheap, and though the design is full of strength and character, it certainly shows the unfitness of the Tuscan order for such a portico.

In Fig. 4 is shown a plan taken on the line *c d* of the base of the column and the top of the pedestal. The projecting corners of the square plinth are shown beyond the curve of the torus, and the solid part of the shaft is shown by the sectioned portion. In Fig. 2 is shown a plan of the under side of the entablature, looking upwards. The sectioned portion shows the lower bed of the frieze on the line *v w*, on which line the section or plan is taken. The lines $a''' b'''$ and $g'' h''$ show the relative positions of the center lines of the columns, their intersection being on the axis of the corner column around which the entablature returns; the moldings of the entablature miter on the line *x z*. In Fig. 5 is shown a half elevation of the curved portion of the shaft of the column and the method of profiling its entasis.

**55.** Before making a comparison of the Greek and Roman orders, let us first consider some of the conditions that made alteration necessary before the art creations of the Greeks could be adopted by the Roman builders.

In *History of Architecture* we read that "the distinguishing characteristic of all Roman architecture is the persistent use of the arch." The Greeks spanned their openings with lintels—simple stone beams laid across from one column to another—and the width of the openings they could thus span was limited by the length of the stones they could conveniently quarry. But, by means of the arch, the Romans could span any width desirable; but the pressure of the arch at the abutments was in the character of a horizontal thrust, which would overthrow any ordinary column, and especially such columns as were used by the Greeks, laid up in several courses and devoid of mortar or cement.

Heavy masonry piers, laid up in strong mortar with securely bonded courses, became necessary, therefore, to withstand this thrust, and the Romans, having no structural use for the Greek orders, applied them as ornament to their masonry abutments.

The orders, thus backed up by heavy piers, did not require that appearance of sturdy independence which the Greeks instilled into their supports, and were consequently drawn out longer and thinner, and embellished by much carving and enrichment, as though endeavoring to attract the attention to their false beauty, while the piers and arches did the real mechanical work of holding up the building.

This will, perhaps, be more clearly understood by referring to Fig. 28, which is a portion of the facade of the Colosseum, at Rome. The arches *v* resting upon the piers *x*, *y*, and *z* support all the mason work above them, while the columns *e*, *f*, and *g*, and the entablatures *h*, *i*, and *j* are applied to the structure simply as ornament. Strip these columns off, and the building will stand as well as with them, but in appearance it will be simply a structural edifice entirely utilitarian, and in no way esthetic.

Greek designers made their architecture beautiful by ornamenting the construction itself—remove the column, entablature, or the pediment, and you remove the essentials of the structure—but the Romans designed the structure entirely apart from the ornament, and the latter might easily be removed without injury to the strength of the fabric.

**56.** The Doric column, as used by the Greeks, was but five or seven diameters in length, and the bottom of the shaft being of the greatest diameter, it required no base to stand on, and was beautiful in its simplicity. The Doric of the Romans, as shown in drawing plate entitled, Doric Order, was, on the contrary, eight or more diameters in height, and the bottom of its shaft was so small, in proportion, that a regular molded base became necessary to give it an appearance of stability. There are instances where the column was used without a base, and the first story of the Theater of Marcellus, at Rome (a detail of which is shown in *History of Architecture*, Fig. 30), is a most excellent example of the struggle to apply the Tuscan details to the Greek form. The lower order of the Theater of Marcellus presents the Tuscan entablature with triglyphs in the frieze and guttæ under the tænia, while the mutules are omitted entirely, and a row of dentils and bed moldings is inserted under the soffit of the corona. The column is not fluted and stands upon the stylobate or plinth without a base, while the capital is molded after the Tuscan model. As a result, this, as an example of the Doric order, is as characterless an ordinance as can anywhere be found, and the alterations of its details brought it finally to the form shown in the above mentioned drawing plate, which is the standard proportion according to Vignola, and, with slight modifications, is the form and detail in which we find the order used in modern work down to the present day.

**57.** The pedestal is higher in proportion to its width than the Tuscan, and its base exhibits more moldings than does the latter. The addition of a subplinth serves to raise the die *B* above the ground line without producing too broad a band under the base. The importance of these items will exhibit themselves when we refer to the use of the orders in interior decoration. The cornice moldings of the pedestal are much like the members of the Tuscan entablature, and show another point of resemblance between these two orders. The base *D* of the column is almost identical with that of the Tuscan order, with the slight addition of a bead molding between the torus and the fillet. The column is fluted with shallow grooves which meet in an arris as in the Greek order, but, unlike the latter, they die out or terminate below the line *c d* which marks the apophyge of the shaft at the base. The capital *F* of the column is decidedly more Tuscan than Greek. It is separated from the shaft by a projecting fillet and bead which in this position is called an *astragal.* Instead of the annulets beneath the echinus as in the Greek capital, we have simply three projecting fillets, and the echinus is rounded out until it becomes in section a mere quarter circle. The abacus is square, but has a crowning member, and it has panels sunk in the corners of its soffit, as shown by the dotted lines at *s*. Fig. 3 is a plan of the under side of the capital and abacus taken on the line *e f* of Fig. 1, showing the under side of the ovolo and the panels sunk in the abacus. The proportions of the entablature are entirely different from the Greek order, and in some examples would scarcely be recognized as Doric at all.

**58.** There are, in fact, two distinct systems of grouping the members of the Roman-Doric entablature: one, as in the Greek, with mutules in the frieze, and the other—an entirely Roman invention—with a course of dentils under the corona.

The mutular Doric is the order shown in the drawing plate; and, as will be at once observed, its entablature bears but a slight resemblance to the Grecian model. The architrave *G* is divided into two facias, the upper one projecting slightly over the lower one somewhat in the manner of the Greek Ionic. The triglyphs of the frieze *H* are always centered over the axes of the columns, and consequently the metopes, which were always square in the Greek order, are often an oblong in the Roman, with the longer axis set either vertically or horizontally.

The mutules, which in the cornice of the Parthenon were set over each triglyph and metope, existed over the triglyphs only in the Roman-Doric structures, and the soffit of the corona between them was paneled in lozenge or rectangular forms, as shown by the dotted lines. A plan of the soffit of the Roman-Doric entablature taken on a line through the frieze is shown in Fig. 2, where $J$, $K$, $L$, $M$, and $N$ are the various shaped panels between the mutules; the line $x z$ denotes the miter of the return. At $a''' b'''$ and $g'' h''$ are the lines on which the centers of the columns are spaced, and their intersection defines the axis of the corner column.

The cornice $I$, Fig. 1, is lighter and more delicate than in the Tuscan order, and its epitithedas is a cyma recta instead of an echinus.

In Fig. 4 is shown a plan of the base on the line $c d$, while $a'' b''$ and $g h$ are its axial lines. The half elevation of the curved outline of the shaft is shown in Fig. 5, and is lettered as in the previous order, and its entasis is drawn in the same manner.

**59.** The result of the Romanizing of the Ionic order is shown in the drawing plate entitled, Ionic Order, and is scarcely more successful than the Doric. The Romans never seemed to understand the possibilities of the order from the Erechtheum, and as a consequence only three accredited examples of the Roman-Ionic column are known today. These are the Temple of Fortuna Virilis, the Temple of Concord, and the second story of the Theater Marcellus. The first of these is by far the best, its volutes retaining much of the Greek character, while the last is the simplest and plainest, and also the smallest in its proportions; but the second is remarkable for its ugliness in general, and the inartistic arrangement of its volutes in particular, which spring out diagonally so as to present four equal and similar faces.

The example shown on drawing plate entitled, Ionic Order, is taken principally from the first of those above mentioned, with only such alterations as are necessary to bring it down to a general type. In it we find the pedestal slightly longer in the die than was the Doric, while the cornice *C* and base *B* of the pedestal are more richly molded than in either of the previous orders. The base *D* of the column, however, is of the familiar Attic type which has already been described in connection with the Greek-Ionic order, and exhibits the first point of strong resemblance to the Grecian ancestor. The shaft of the column is nearly of the same height as the Greek; and in many examples is grooved by twenty-four flutes separated by fillets, though in this example there are but twenty.

By a strange perversity, however, when we arrive at the capital we meet a striking difference from the Athenian order. In the columns of the portico of the Erechtheum we have a *necking*, between the echinus of the capital and the astragal of the column; but in the Roman Ionic the flutes of the shaft extend almost to the eyes of the volutes. In their Doric order the Romans inserted a necking above, which did not exist in the Greek order and must have been borrowed from the Attic Ionic, or possibly from the Tuscan; but when they adopted the Ionic order they seem to have taken especial pains to omit the detail which, according to previous appearances, they particularly admired. For some reason, they omitted this necking, and the Roman-Ionic capital has a flat, crushed appearance in consequence, as shown. In carving the volutes of the capital, they simplified the Greek spiral greatly, not necessarily from choice, but probably from necessity. The Roman designer was a mathematician, but not an artist; he was a clever engineer, but hardly an architect; and consequently he tried to reduce the Greek spiral to a simple geometrical rule, and in the same manner as he struck the curves of his moldings—with a compass—he produced the volute for his capital with tangent arcs of different circles. The method used by the Grecian architects in executing the spirals of the Ionic columns, remains to this day more or less a matter of conjecture. No method had been discovered to reproduce them exactly during the age of Roman art, and today we have to rely upon the results of modern investigation to reproduce them with any degree of accuracy. The Roman-Ionic volute contains but one band, while that of the Greeks possessed three, though there are instances where a single band was coiled in the capital of the Greek order, as in the temple on the Ilissus River, Fig. 21. But the Ionic order reached the zenith of its perfection in the Erechtheum, and it is with the details of that building we must compare any subsequent Ionic constructions.

The architrave *G* and frieze *H* of the Roman order are very similar to those of the Greek, but between the frieze *H* and corona of *I* is inserted a row of dentils with upper and lower bed moldings, which cast a serrated shadow and emphasize the projection of the corona.

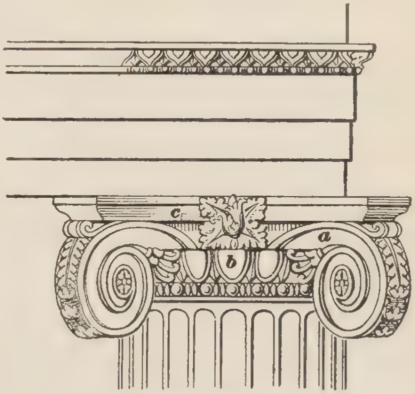


FIG. 24.

**60.** The Ionic capital above referred to in the Temple of Concord is illustrated in Fig. 24. It is shown here not on account of its architectural beauty, for it has none, but because in certain classes of early Renaissance work this style of cap was redesigned by Palladio and used in combinations where its defects were not so glaring. The principle upon which this cap is designed is that the volutes *a* are growing out, and curling over the edge of the contracted echinus *b*, while the whole is covered with an eight-sided abacus *c*, strongly resembling the Corinthian. The space under the abacus and between the volutes is filled with a carved rosette, or in a few instances with an animal's head. More will be learned about this particular form of Ionic capital when we take up the subject of Renaissance design.

In Fig. 4 of the drawing plate is shown a plan of the base of the column, as well as the top of the pedestal. This plan is taken looking down on the column cut through on the section line *c d*, and the lines *a″ b″* and *g h* are axial lines through the center of the base.

Fig. 3 shows a plan of the under side of the capital, looking upwards; it shows the bolsters on the side of the column and the projecting echinus on the front and back.

In Fig. 6 is shown an enlarged diagram of the volute and and the adjacent members composing the necking of the column; this diagram is just four times as large as the volute, shown in the main elevation of the capital, and is drawn to a proportional scale.

**61.** The curves of the spiral of the volute are drawn as follows: At right angles to the line *i j* draw the line *k l*, and draw a line through *k k* at a distance of 15 parts above the line *i j*; the diameter of the *eye* of the volute, being $\frac{1}{4}$ of this distance, will be $3\frac{3}{4}$ parts. From the point of intersection of the center line *i j*, and the line *k l*, with a radius equal to $1\frac{7}{8}$ parts, describe the circle representing the eye; as the spiral line is composed of simple arcs, each being $\frac{1}{4}$ the circumference of a circle, it will be necessary to establish a series of centers from which the arcs may be described, and as the volute makes 3 complete involutions, 12 centers will be required. The method of establishing these centers is more clearly shown in Fig. 7, where a circle is described on the axial lines *a b* and *c d*, with a diameter 3 times the diameter of the eye shown in Fig. 6; the lines *a c*, *a d*, *b c*, and *b d* are then drawn, and the lines *a c* and *a d* are bisected in points *2* and *1*, respectively, and radial lines are drawn from these points to the center of the circle. The line *2–12* is then divided into three equal parts, giving the points *6* and *10*. Through points *2*, *6*, and *10*, lines parallel to *c d* are drawn, and the vertical distance between the line *2–1* and *c d* is thus also divided into three equal spaces. Now the line *3–4* is drawn, at a distance from *c d* equal to $2\frac{1}{2}$ of these spaces; from points *2* and *5*, vertical lines defining the points *3* and *4* are drawn, and from the latter points diagonal lines at an angle of 45° are drawn intersecting on line $c\ d$; verticals from *6* to *7*, *10* to *11*, and *9* to *8*, and horizontals from *7* to *8* and *11* to *12* complete the figure; the centers for drawing the arcs are *1*, *2*, *3*, *4*, etc., and are used in the order in which they occur. Locate these centers in the eye of Fig. 6 by the method followed in Fig. 7, and proceed to draw the arcs. From the center *1*, with a radius equal to $1–1_1$, draw the arc $1_1–2_1$; from center *2*, with a radius equal to $2–2_1$, draw the arc $2_1–3_1$, and continue thus until the outer line of the volute is complete. The method of drawing the inner line of the volute will be found in *Advanced Architectural Drawing*. The reversed dotted curve $k\ n\ o$ shows the curvature of the strap of the bolster on the center line $g'\ h'$ of Fig. 3.

In Fig. 2 is shown a plan of the soffit of the corona, looking upwards from the line $v\ w$ of Fig. 1; $a'''\ b'''$ and $g''\ h''$ are the axial lines on which the columns are spaced. The method of profiling the entasis is shown in Fig. 5, and is similar to the previous cases.

**62.** We now come to the Corinthian, which we may consider a typical Roman order. There is but one example of richly foliated capitals in all Grecian art, and the modern Corinthian order, though probably taken from it, bears but a general resemblance to its prototype. We have gone into the details of the Grecian-Corinthian capital, and the Roman style will only be dwelt upon where it contrasts with the details of the Greek. The Roman-Corinthian capital, shown at $F$ in drawing plate entitled, Corinthian Order, has two rows of leaves, eight in each row, so disposed that of the taller ones composing the upper row, one comes in the middle beneath

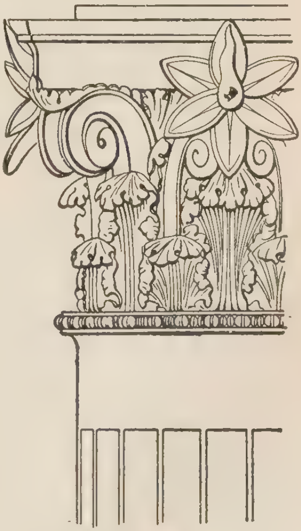


FIG. 25.

each face of the abacus, and the lower leaves alternate with the upper ones, coming between the stems of the latter; so that in the first or lower tier of leaves there is in the middle of each face a space between two leaves occupied by the stem of the central leaf above them. By comparing this with the Greek order we find the principal difference between them lies not so much in the leaves themselves as in their number and arrangement; the capital from the monument of Lysicrates being a simple and refined arrangement of leaves and tendrils, while in the capitals from the Temples of Vesta, Fig. 25, and Jupiter Stator, Fig. 26, the foliage is more luxuriant than refined. However, it is a characteristic of all Roman architecture that luxury should exceed refinement, and we will see this in every detail of the two last of the Roman orders.

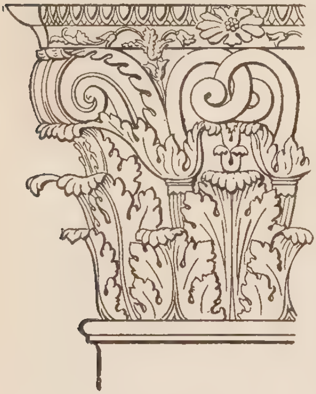


FIG. 26.

**63.** In drawing plate entitled, Corinthian Order, the example is not taken from any particular edifice, but is compiled from a number of different structures, in order to get a general type of the order. The shaft here is fluted with twenty-four flutes, though in many of the best examples it is not fluted at all. The portico of the Pantheon possesses one of the handsomest examples of the Corinthian order in Rome, but the granite columns are left unfluted, and their surfaces are highly polished to compensate for the omission (see Fig. 33, *History of Architecture*). The base of the Corinthian column varies somewhat in different examples, but is most frequently an enriched variation of the Grecian Attic. It is scarcely necessary to comment on the pedestal of either the Corinthian or Composite orders, as there is no change from the pedestal of the previously described orders, except an elongation of the die and an increase of the number of the moldings which ornament its top *C* and base *A*. The same may be said of the base *D* of the column, the only change from the previous orders being an increase of the members between the two torus moldings. The shaft *E* of the column is but slightly longer than in the Ionic order, but the increase in the height of the capital makes the entire column ten diameters high. The entablature, however, is very different from any we have yet described. The architrave *G* is divided into three horizontal bands, or facias, as was the Ionic, but instead of a plain projection of one facia beyond the other, they are separated by a number of different small moldings, which, in nearly every instance, were carved and enriched almost to excess. The frieze *H* is here shown as plain, but the majority of examples show it carved in high relief. The cornice *I* exhibits the greatest alteration from the previous orders that we have yet seen. A row of dentils are supported by a cyma reversa immediately above the frieze, similar to the Ionic arrangement; but immediately above this we have a heavy ovolo supporting a row or course of *modillions.*

**64.** A **modillion** is the projecting bracket supporting the corona of the Corinthian entablature, as shown in Figs. 7 and 8 of the above drawing plate. These brackets possess a volute somewhat similar to that of the Ionic capital. but curved in the opposite direction.

**65.** The entasis of the column is profiled as in Fig. 5, where the reference letters are the same as in the previous plate. Above the modillions in the entablature are the corona and cyma recta, as in the Ionic. All these moldings are usually richly ornamented, and the entire order is usually decorated as lavishly as unrefined taste and unlimited purse could combine to make it. The moldings of the abacus, the tori of the base, and even the flutes of the shaft were in many cases enriched beyond all idea of temperance and good taste.

The character of the ornament carved upon the moldings is described in the chapter upon classic moldings, but the enrichment of the flutings was different. It was customary to carve the flutings as though a rope was laid in them from the apophyge at the bottom of the shaft, up one-third its height. These rope moldings or ornaments were sometimes plain, straight rods, but in most cases were carved as twisted rope, or braided, and the upper two-thirds of the column was of ordinary fluting or was left unfluted.

In Fig. 6 is shown a half plan of the under side of the capital on the line *i j*; Figs. 2 and 3 show a corner elevation and a plan of the under side of the bell, or body, of the capital, with the leaves $a'$ and $b'$ removed. At Fig. 4 is a plan of the base on the line *c d* of the elevation. In Figs. 2, 3, and 4, the vertical axial line $a'' b''$ passes through the center of each detail as does *a b* in the elevation, and the line $g' h'$ marks the transverse axis of the plan of the base, while $g'' h''$ is the axial line passing through the corners of the abacus. The concave sides of the abacus are formed with an arc of a circle, having its center at the apex of an equilateral triangle, whose base connects the intersections of the axial lines with the corners of the abacus.

In Fig. 9 is shown a plan of the under side of the cornice showing the mitering of the members on the line *x z*. The axial lines $a''' b'''$ and $g''' h'''$ both pass through the centers of modillions, as these details must always be spaced so as to center over the columns.

**66.** It is not the intention of the plates herewith given to furnish a pattern by which each order shall be constructed, but to establish a general proportion which will enable the student to lay out his columns and entablature and execute such enrichment as he may see fit or as circumstances may dictate. The dissimilar varieties belonging to the same order, which we find in ancient art, show plainly that the architects of antiquity considered themselves at liberty to design their own detail and to treat an order as a composition, marked out for them in its leading forms and general proportions, and in no instance do we find the liberties taken so great as in the Corinthian order; the arrangement of the leaves, the size of the volutes, the molding of the abacus, vary in different examples until it is hard to decide whether some of them do not belong to a different order, and if we do classify some of them in an advanced order, the difficulty then presents itself as to where to draw the line.

Between the Corinthian and Composite orders there is very little difference except in the size of the volutes, and with the exception of the capital of the column there is scarcely any difference in the proportions of their parts. Drawing plate entitled, Composite Order, shows the general form of this essentially Roman composition, but omitting entirely the ornamentation of the frieze and moldings which is as much a part of this order as the triglyphs are of the Doric. Ornamentation as a rule forms no part of the order which it enriches, and consequently should not be considered a part of the structure of the order, but the Composite order was invented by the Romans for no other purpose than to carry heavy ornamentation; in fact, it was the excessive and extravagant ornamentation of the Corinthian order that caused the Composite to spring into existence, and our example is, therefore, not complete until it receives such ornamentation as may be appropriate to its purpose. The general form is here given and the application of ornament will be discussed later in its proper place.

The pedestal of the Composite order is almost identical with that of the Corinthian, there being but a few slight changes in the moldings of its base and its cap while the die is a trifle longer. The base, shaft, and capital of the column are the same height as the Corinthian, and with the exception of the capital are almost the same in design. The architrave, frieze, and cornice have the same relative proportions as in the previous order, but are treated somewhat more elaborately in the subdivisions of their parts.

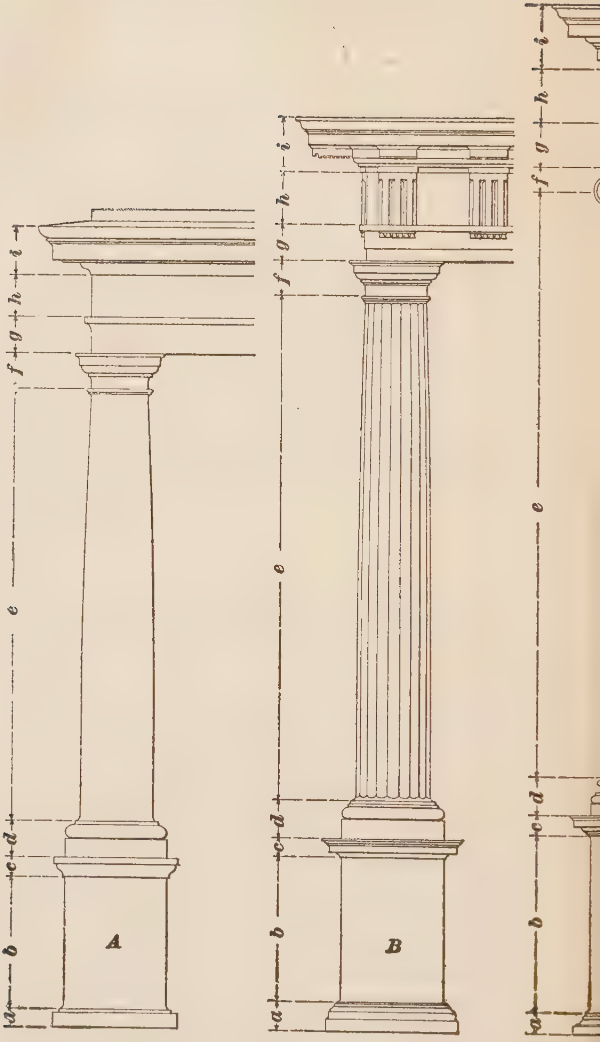
The Composite capital is a combination of the Corinthian and the Ionic capital from the Roman Temple of Concord, heretofore referred to. It is not an artistic combination, but its broad, strong volutes give an unusual surface on which to carve florid ornament, and as such it suited exactly the later-day admirers of everything strictly Roman. It suits its place in modern art very well, when in proper handling, but the Renaissance architects were conspicuous in Italy by the interior application of the Composite order in every spot where it did not belong.

The volutes of the Composite capital are described in the same manner as those of the Ionic order, the radius of the eye being one-eighth of the distance from the top of the volute to the center. The arcs of the volute are then described from the centers located as shown in Figs. 7 and 8, in the same manner as for the Ionic order.

Figs. 2 and 6 show plans of the under side of the capital on the line *ij*, and in Fig. 3 is a corner elevation of the capital, the left half showing the relative position of the leaves on the bell, while the right half shows the relation between the abacus and the bell, or body, of the capital. Fig. 9 is a plan of the soffit of the corona, and Fig. 5 is a half elevation of the entasis of the column. All reference letters on Figs. 2, 3, 4, 5, and 9 refer to the same parts as similar letters on the Corinthian plate.

**67.** Having considered each one of the five orders separately, and measured the proportions of each of its parts in terms of the semi-diameter, we will now compare the orders as a whole.

The fact that the Tuscan order is but seven diameters in height, while the Corinthian order is ten, is likely to leave the student with the impression that the latter is a taller or bigger order than the former. This, in point of fact, is not so, as no direct comparison can be made between two architectural features so widely different in their origin and application. A Tuscan column of the same diameter as a Corinthian would necessarily be much shorter, but in an architectural composition where one would be appropriate, the other would be entirely out of place, thereby rendering a comparison impossible. On the other hand, a Corinthian column of the same length as a Tuscan column would naturally have a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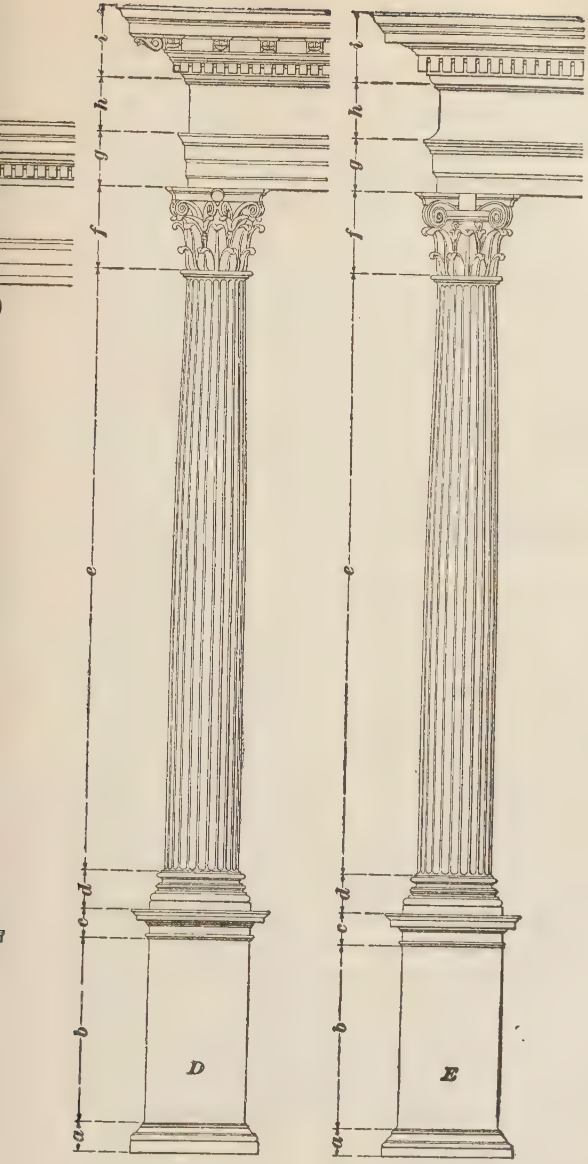

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smaller diameter, but for similar reasons no direct comparison can be made.

Therefore, for practical purposes, we should consider each of the orders simply as a *system*, the magnitude of whose parts depends entirely upon the order itself, and this magnitude is in no way derived from any other source, except as regards the proportion of the whole to the space it has to occupy.

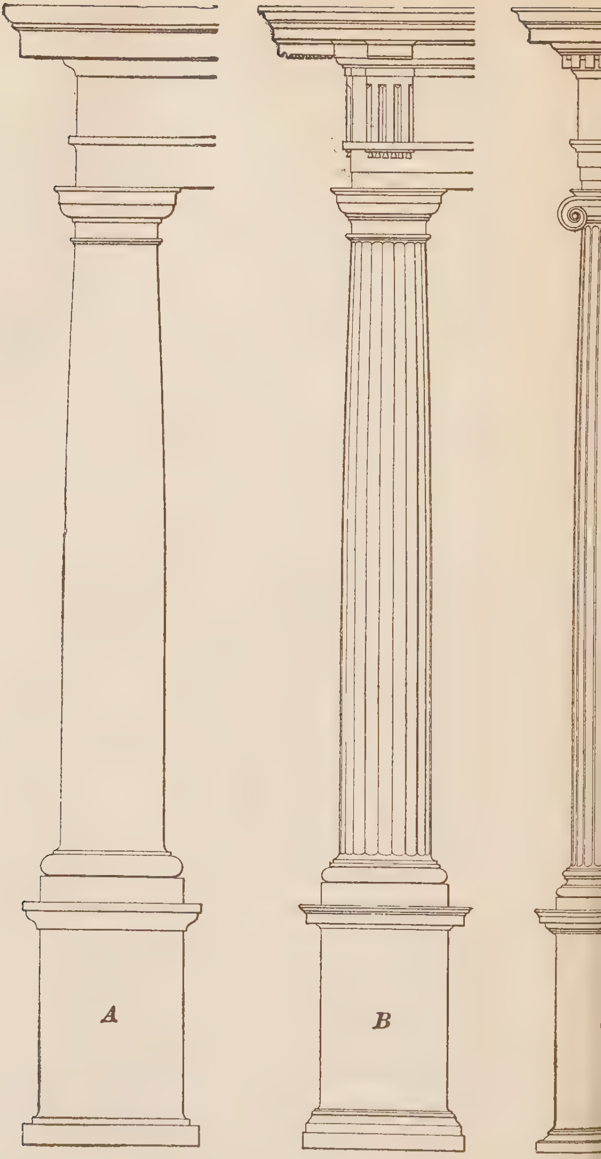
In Plate I is shown a group of the five orders, in which the columns are all of the same diameter, and the pedestal and the entablature of each are in the proportion required for each order. Comparison will now show that the height of the pedestal *a b c*, the length of the column *d e f*, and the depth of the entablature *g h i*, though different in each of the orders, are relatively the same in all of them; that is, in each case the height of the pedestal is one-third the length of the column, and the depth of the entablature is one-quarter the length of the column.

Therefore, if we draw the columns in the five orders to a uniform length, as is shown in Plate II, we shall have all the pedestals of the same height and the entablatures of a uniform depth, while the diameters of the columns and the pedestals will vary according to the order.

Thus we find one set of proportions common to all five orders, and in any problem in architectural design where an order is to be a feature, we have first to divide the vertical space that the order is to occupy into nineteen equal parts, four of which are assigned to the pedestal, twelve to the column, and three to the entablature; or, if no pedestal is to be used, we divide the space into fifteen parts, assigning three to the entablature and twelve to the column. The diameter of the column is then ascertained, by subdividing the space assigned to it into seven, eight, nine, or ten parts. according to the order, and the other proportions are filled out, by taking one-half the subdivision as the module.

**68.** Thus we complete the study of the only architectural forms that will permit a mathematical analysis of their proportions. Every detail of the five orders of Architecture can be measured in terms or parts of the diameter of its column, and we are thus enabled to study and compare different examples of the same order, though built on entirely different scales. As has been said before, these proportions are not absolute and are subject to such slight variations as modern circumstances may require. For example, when an architect designs a column for a modern building, he uses the classic proportions only to block out his lines, and the material, situation, and purpose of the support determine the details of its design. A small wood column supporting an interior arch would be grooved perhaps by twenty-four flutes; whereas, if the same size shaft were to be cut from stone, twenty, or even sixteen, flutes would probably be as many as would be proper — simply because one material admits of finer working than the other, and the trained eye recognizes an overworked or underworked ornament immediately. An ornament carved in wood might look crude and unfinished, because the cutting was not deep or delicate enough, whereas the same amount of detail in stone would possibly be considered excessive. The situation of the ornament or column, as regards the eye, also affects the proportion of its parts. The modillions of a cornice which crowns the top of a high building are much more crude and excessive in their proportions than the simple and delicate plaster brackets which ornament the borders of the ceiling of a room; and finally the purpose of the column, modillion, or other detail will determine still more positively just how much the proportions given in the five orders shall be deviated from. If a column is supporting a heavy mass of masonry, the eye at a glance can tell that there are tons and tons of weight upon it, and the column must be crude and strong and heavy in its proportions, in order to satisfy the eye; whereas, on the other hand, if the column forms one side of an entrance and simply carries a light entablature, it will appear to the best advantage when the proportions of its parts approach most closely to the formal relations as given in the five orders.

The five orders are therefore given the student to practise



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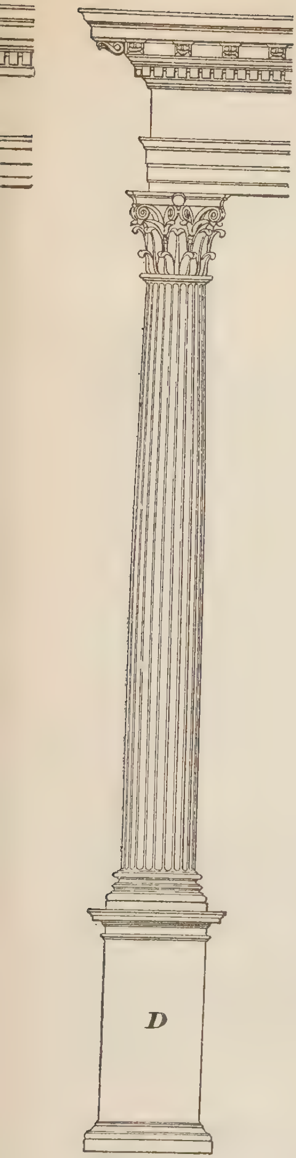
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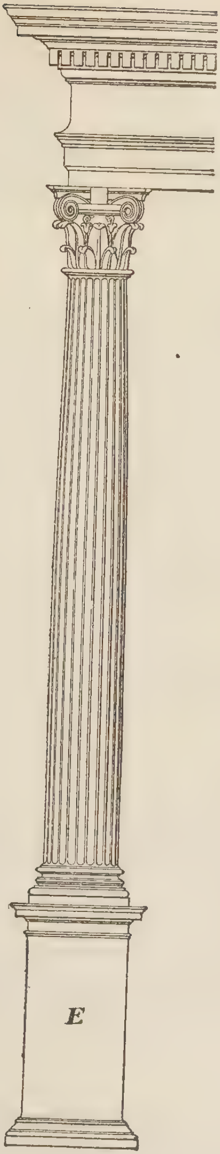
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by, in the same manner as a writing teacher gives a copy of letters and words, but when the student becomes proficient and discards his copy, he develops in his handwriting, character and individuality. In the same manner, the architectural student will develop in his designs personal characteristics, which give variety to the work and prevent the use of the orders degenerating into a mere copying of the forms of ancient classic art.

## CLASSIC MOLDINGS.

**69.** The architectural purpose of moldings is twofold: first, they give variety to the outline of the principal divisions of an order, such as the base, capital, entablature, etc.; and second, they serve to divide the vertical surfaces and cast horizontal shadows which accentuate the divisions, thus preventing monotony in the general mass. In either case the contour, or profile, of the molding is of vast importance, as upon this contour depends the subtlety of the play of light and shade and the strength and depth of the shadows, and the character of the general outline.

The principal moldings found in classic architecture are eight in number, and each is known by the name describing its shape or general purpose.

**70.** The **fillet** *A*, Plate III, is simply a square-edged band, rarely ornamented, and generally used in connection with some other molding. It is much used to separate the individual members of a group of moldings, as in the base and capital of a column, and also to emphasize the divisional line between the surfaces of distinct members, as in the entablature, between the architrave and the frieze. The *fillet* derives its name from the Latin word *filum*, meaning a thread.

**71.** The **cyma,** shown at *B* and *C*, Plate III, is an undulated molding, of which there are two forms, namely, the *cyma recta*, which is concave in its upper part and convex beneath, as shown at $B$, and the *cyma reversa*, which is convex above and concave beneath, as shown at $C$. The cyma recta is frequently seen as the crowning member of cornices, in which situation it acts as a covering, or hood, to shelter the lower members; on this account it is often referred to as a *crown molding*. From the slender aspect of the upper curve, it is not well adapted for use as a supporting member and is rarely so used, but its contour pervades all classic ornament as the outline of enrichment on flat surfaces and for the graceful lines of foliage where the same is either carved or painted upon the members of an order. The cyma recta is frequently ornamented with designs of the honeysuckle or other floral devices, which are carved in relief on the face of the molding, and not sunk beneath its surface, as was the custom of the Egyptians. The shadow cast by this molding is very sharp and black at the top and bottom, blending off towards the center, where the full strength of the light is shown.

**72.** The **cyma reversa** $C$ has all the varieties of curve possessed by the former molding, but the tangent connecting the two curves is nearer horizontal, and the curves themselves are more deeply cut. It is more frequently enriched than the cyma recta, and like it may be found throughout all classic ornament; but it is particularly important in the capital of the Grecian-Doric column, where the subtle curve from the shaft of the column to the echinus of the capital is one of the most refined conceptions of the classic orders. The inverted outline of this molding conforms to the contour of the bases of the classic columns. Unlike the cyma recta, it is well adapted for use as a supporting member, and this expression of support is well exemplified in the Doric capital above referred to, where the weight of the overhanging architrave is so gracefully transmitted to the neck of the sturdy shaft. Both forms of the cyma are also known as the *ogee*, signifying a curve of contrary flexure.

The term *cyma* is derived from the Greek word *kyma*, meaning a wave, while the adjectives *recta* and *reversa* define the position—the former meaning upright, and the latter meaning reversed, or opposite.

**73.** The **cavetto,** or cove, $D$ is a concave molding whose outline is almost identical with the upper part of the cyma recta. It is used both as a crowning member and as a means of obviating the sharp angle which, without it, would occur between a facia and a fillet, but it is never seen in bases and is never ornamented. The shadow produced by the cavetto is sharp and black at the top, gradually diminishing in intensity until it disappears entirely at the bottom. The term cavetto is an Italian diminutive of *cavo*, a hollow.

**74.** The **ovolo,** or **echinus,** also sometimes called the *quarter round*, is shown at $E$; it is an egg-shaped molding whose outline corresponds very closely to the upper part of the cyma reversa. Its general contour pervades all classic ornament, and as a molding it always occupies a position above the eye and is almost invariably enriched with an egg-and-dart ornament cut into its surface. As a supporting member, the ovolo is well adapted and is frequently seen under the abacus of a capital or in the angle of the soffit of a corona. The terms *ovolo* and *echinus* are from the Latin and the Greek, respectively, and each in its own language means an egg.

**75.** The **bead** is a small rope-like molding, shown at $F$. Its section is rather more than a semicircle, and, though seldom used by itself, it is often found in connection with the fillet, separating two larger or more important members, or dividing a large vertical surface by a long broken shadow, as between the facias of the Roman-Corinthian architrave. It is also much used as a neck molding between the top of the shaft and the capital, in which position it expresses the function of binding and strengthening the top of the shaft. The bead molding is nearly always carved into a series of globular and disk forms, from which it derives its name.

**76.** The **scotia** $G$ is a hollow molding, used almost entirely in the bases of columns between the fillets which accompany the two torus moldings. Its contour is identical with a reversed ovolo, and it casts a deep, dark shadow, for which it is most frequently used in positions falling below the eye of the observer, where it thus contrasts and strengthens the effect of the adjacent moldings, while it gives much variety to the outline of the base. Its name is from the Greek *skotia*, signifying darkness.

**77.** The **torus** *H* is the principal molding used in the bases of the columns in all the five orders. It is rope-like in form, and when wound around the bottom of the shaft it gives, like the bead, an expression of binding strength. It is generally used twice in the bases, but is separated by a scotia, as stated above. The upper torus of a base is generally the smaller, and with the apophyge, or escape of the shaft, an inverted cyma reversa is formed, while the lower torus and the scotia form the same feature on a larger scale. This shows that the torus and scotia refer to the same principle when in composition, but they are never used together except in combination as a base. The shadow produced by the torus molding is very sharp and heavy at the bottom, graduating towards the top, where the full light falls upon it. Its name is from the Latin, and signifies a protuberance or swelling.

**78.** Grecian architecture is distinguished by the grace of its proportions and the beauty of its outlines, the latter being governed largely by the contour and projection of its moldings, while the spacing of these moldings determines the proportions and subdivisions of the height.

Roman architecture, on the contrary, is chiefly remarkable for the magnificence of its construction and the elaborate ornamentation of its details, without that delicacy and refinement which expresses itself in every line of the Grecian monuments. Roman moldings, though identical in name and similar in shape to their Grecian prototypes, are materially different in actual profile, owing to the different principles employed in establishing their contour.

The outlines of the Greek moldings will be found, in nearly every instance, to follow the curves of the conic sections, generally the hyperbola or parabola, occasionally the ellipse, and very rarely the circle.

The Roman moldings are, on the contrary, nearly always formed from the arcs of one or more circles, and for this reason their profiles are deficient in that expression of delicacy and refinement which characterizes the details of the Greek monuments.

Before analyzing the outlines of these Greek moldings and the methods of contouring them, let us first give our attention to the conic sections from which they seem to have been derived.

**79.** At *I*, Plate III, are shown two similar cones, *a b c* and *a d e*, which are in contact with each other at their vertices *a*, and whose bases *b c* and *d e* are circular and at right angles to the axes *a f* and *a f'*.

If either of the cones be intersected or cut by a plane, which is parallel to one of its elements or sides, as *b c*, the line of intersection will be a parabola as at *g h i*; but, if, instead of being parallel to the side *b c*, the cutting plane makes an angle with it, the curve formed by the intersection will be either an ellipse or a hyperbola, according to the angle. It will be an ellipse when the cutting plane is more nearly parallel with the base of the cone than it was in the case of the parabola, and passes through both sides as at *j k*; and the line of intersection will be a hyperbola when the cutting plane is more nearly perpendicular to the base than it was in the case of the parabola, as shown at *l m n* and *o p q*.

**80.** In the case of the hyperbola, the plane will always cut both cones, thereby giving two branches to the curve, and these branches will be farther apart as the cutting plane recedes from the axes of the cones. The nearer the plane approaches the axes of the cones, the straighter will become the sides of the intersecting curve, and as the plane recedes from the axes, the rounder and nearer circular will be the intersection, though no matter how closely the curve of intersection may approach the arc of a circle, it can never become absolutely circular in form.

The hyperbola becomes two intersecting straight lines when the plane passes through the vertex; these two lines are most divergent when the plane is parallel with the axes of the cones, and gradually become closer together as the plane approaches a position parallel with the side of the cone, where the hyperbola reaches its limit in a straight line. This straight line is the common limit of both hyperbola and parabola, as any deviation from it will produce one or the other of these curves, according to the direction of that deviation.

As the plane of the ellipse becomes more nearly parallel to the base of the cone, the ellipse approaches the form of a circle, which it finally becomes, when the axis of the cone and the cutting plane are perpendicular to each other, as at *r s t*, and as the plane of the ellipse approaches the vertex of the cone the ellipse diminishes in size until it reaches its limit in a point. From a point to a circle, then, is the limit of curvature of the ellipse.

In *Geometrical Drawing*, methods are given in examples 23 and 25 for drawing an ellipse and a parabola of any desired proportions, and it is only necessary to add here the method of contouring the hyperbola.

**81.** To draw a hyperbola of a given width and height, the axis *a b*, at *J*, is laid down perpendicular to the width *c d*, in the same manner as for the parabola, and the rectangle *c d f e* is constructed with *c d* equal to the base of the hyperbola, and the height *c e* equal to the axis *a b*. Divide one-half the base and, also, each side into any number of equal parts, and connect the points of division on the sides with the vertex *a* by means of the lines *a 1*, *a 2*, *a 3*, etc. The points of division on the base are connected by lines to some point *x* on the line of the axis *a b* extended; the points of intersection of these two series of lines will determine points on the hyperbolic curve, taking the lines in the order as they recede from point *c*; *x* can be at any distance above *a*, and the curved lines *a c* and *a d* will approach more nearly the curves of the parabola as the point *x* becomes more remote. On the other hand, the nearer the point *x* is to the vertex *a*, the more *a c* and *a d* will approximate to a straight line, and when points *x* and *a* coincide, the line *a c* will be a straight line.

To draw a tangent to any point of the hyperbola, first draw a line from the desired point *g* perpendicular to the axis *a b*, and on the extended axis *a x* describe the semicircle *a k x*, with a radius *l a* equal to $\frac{1}{2}$ *a x*; then with a radius equal to $\frac{1}{2}$ *l h*, describe the semicircle *l k h* intersecting *a k x* at *k*; draw *k i* perpendicular to *a x*, and connect *i g*; then will *i g m* be the tangent required.

**82. Greek moldings** can be divided into three classes, according to the number of mathematical curves comprising their outline.

In the *first class*, composed of a single mathematical curve, generally a hyperbola or parabola *E*, Plate III, the point *d*, the direction of the axis *a x*, and the ordinates *a b* and *b d* must be determined upon before we can trace in the curve. If the curve is to be a parabola, the base *b d* and the side *d c* are divided into the same number of equal parts, and points on the curve are found by the method laid down in example 25 of *Geometrical Drawing*.

If the curve is a hyperbola, the base and sides are divided as before, and the point *x* is located on the axis from one-half to three and one-half times *a b*, according to the convexity desired. A good way to do is to draw the curve in very lightly, freehand, and draw any line, as *a 1*. Then through the point *o*, where *a 1* cuts the freehand curve, draw *o 1* and extend it until it intersects the axis *a b* extended; this point of intersection will be *x*, and by drawing the other guide lines the points may be determined through which a curve of the desired convexity can be drawn.

**83.** The *second class*, shown at *C*, is composed of two mathematical curves. We generally find a combination of the hyperbola and ellipse united by a common tangent, of the parabola and ellipse united by a common tangent, or of two ellipses united by a common tangent.

When the molding is composed of the arcs of a hyperbola and an ellipse, as at *C*, the points *a*, *d*, and *g* must be determined before the molding is outlined. The hyperbola is then drawn through the points *a*, *d* in the same manner as for moldings of the first class, and the tangent *h f* is drawn through the point *d*; *g k* is drawn parallel to *h f*, and *d k* is drawn at right angles to *g k*. *g k* will then be one-half the major axis, and *d k* will be one-half the minor axis of the required ellipse.

When the molding is composed of the arcs of a parabola and of an ellipse, the procedure is the same as before, except as to the drawing of the tangent *h′ f′*. After outlining that portion of the molding limited by the arc of the parabola, the distance *a′ m′* is laid off equal to *a′ b′*, and the line *d′ m′* will then be tangent at the point *d′*. The ellipse is then drawn as in the previous case.

When the molding is composed of the arcs of two ellipses, the points *a″* and *g″* are determined and the point of tangency *d″* located before the curves are drawn; then *g″ k″* and *b″ a″* are drawn equal to one-half the predetermined major axis of the ellipses, and *d″ k″* and *d″ b″* are drawn equal to one-half the minor axis of the particular ellipse to which they belong. The ellipses are then outlined as before.

**84.** The *third class* of moldings, composed of three curves, generally the arcs of circles combined with the arc of an ellipse, is found almost entirely in the details of the antæ caps and especially in that detail known as the *bird's-beak molding*.

A section of the bird's-beak molding is shown at *M*, where the principal curve *a d* is the arc of a hyperbola. The curve on the under side *l k j* is composed of the arcs of two tangent circles, *k l* being described with the radius *g k*, and *j k* with the radius *h j*. The centers of both circles being on the line *g k*, they are tangent at *k*. The arc *j m* is a part of an ellipse.

The application of the curves of the conic sections to the cyma recta is shown at $B$, and to such members as the *facia* and *soffit* of the corona at $K$ and $L$, Plate III; the methods used in profiling these outlines are precisely the same as above set forth.

**85. Roman moldings** are almost invariably profiled to the arc of a circle, or to the arcs of two tangent circles, thus giving them a feeling of harshness and lack of spirit.

Compare the three Greek outlines of the cyma recta $B$ with the Roman form shown at $B'$. The Greek form, capable of unlimited variety through the use of the ellipse as at $a$, the parabola at $b$, or the hyperbola at $c$, is infinitely superior, by virtue of its grace and beauty, to the limited outline that can be obtained in the Roman form, where the contour is but two tangent arcs of the same circle whose radius is revolved alternately outside and inside the profile line. The same may be said of the cymæ reversæ $C$ and $C'$, where the Roman form has always the same even curve, while the Greek outline $C$ is ever changing and never monotonous from its commencement to its end. The cavetto $D$ and the ovolo $E$ possess the same difference from their Roman namesakes $D'$ and $E'$ as do the above mentioned cymæ, and, as can be readily seen, it is from the Roman form of the ovolo that the name *quarter round* is derived, its profile being exactly a quadrant of a circle.

The Roman bead $F'$ is usually no more than an even semicircle in section, while the Greek form is fully three-quarters of a circle, the extra projection serving admirable to emphasize the line of junction between the molding and the surfaces from which it projects.

The Roman scotia and torus are each formed from the tangent arcs of two circles, as may be seen at $G'$ and $H'$, while the Greek moldings of similar name are in profile the arc of some conic section.

There are examples of Greek torus moldings whose profiles are the arcs of circles, or of very broad ellipses, but these, with the bead and bird's-beak moldings, described heretofore, are the only examples of circular profiles in all Grecian detail.

The beautiful graduation of light and shade upon the surfaces whose curve is a conic section was well understood by the Greeks, and it is in the rarest instances that we find them using the arc of a circle as an outline for any molding of prominence. Observe that at *M* the main curve *a d* is a hyperbola, but the portion undercut at *d k j* is so hidden and remote, that the arcs of circles were considered sufficient for its contour; while the finishing curve *j m*, which was to be more plainly seen, was formed from the arc of an ellipse.

While the various moldings can thus be profiled by geometric methods, such as have been shown, the student will find, as he advances in the art, that the most effective profiles can be drawn by the hand alone, directed by judgment and good taste.

## INTERCOLUMNIATION.

**86. Intercolumniation** is the clear distance between the lower part of the shafts of any two columns in a colonnade; and, when columns are properly spaced, this distance will vary in different orders. In the Tuscan, for example, no great exactness of spacing is required, as there are no ornaments in the entablature to be spaced; but in the Doric order, the intercolumniation must be such that the triglyphs will occur over the axes of the columns, while in Ionic and Corinthian orders, the dentils and modillions will strictly govern the intercolumniations.

**87.** The ancient names of the most frequent proportions for intercolumniations are: *pycnostyle*, where the space between columns is $1\frac{1}{2}$ diameters; *eustyle*, where $2\frac{1}{4}$ diameters is the interval; *diastyle*, where the space is 3 diameters; and *aræostyle*, where the intercolumniation is 4 diameters. Still another and somewhat variable system of intercolumniation is the *systyle*, where the columns are spaced farther apart than in pycnostyle, but not so far apart as in eustyle. These rules may be varied to suit circumstances, and are only laid down to give a basis upon which to systematize the intercolumniations of a colonnade or arcade, as will be demonstrated later.

**88.** As said before, the triglyphs govern the intercolumniations in the Doric order, and reference to Fig. 27 will explain more fully how this is. Here is shown a portion of an entablature of the Doric order with the columns *A* and *B* spaced in pycnostyle at *a*, where the intercolumniation is $1\frac{1}{2}$ diameters. The triglyphs *t* are spaced $2\frac{1}{2}$ modules, or $1\frac{1}{4}$ diameters, from center to center, and intercolumniation *a* places the columns under every second triglyph, and $2\frac{1}{2}$ diameters from center to center, or $1\frac{1}{2}$ diameters apart. Intercolumniation *b* places the columns *B* and *C* under every third triglyph, which makes them $3\frac{3}{4}$ diameters from center to center, or $2\frac{3}{4}$ diameters apart. This intercolumniation is, therefore, diastyle, or nearly so, and is as close to three diameters as the columns of the Doric order can be regularly placed. Intercolumniation *c* leaves three triglyphs between

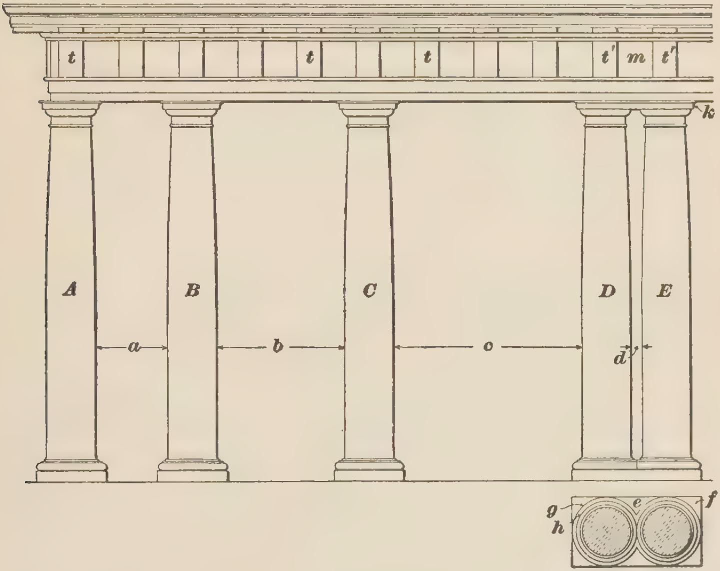

FIG. 27.

columns *C* and *D*, and as these triglyphs are $1\frac{1}{4}$ diameters on centers, the clear space between columns *C* and *D* is exactly 4 diameters, and is, therefore, aræostyle. As it is frequently necessary to couple two columns, as *D* and *E*, in order to give to a structure a proper expression of stability where the intercolumniations are great, as in the colonnade of the Louvre, shown in Fig. 106, *History of Architecture*, a rule for spacing them is laid down for each of the orders. In the Doric order, these columns are placed under the centers of adjacent triglyphs, which leaves the space *d* but $\frac{1}{4}$ of a diameter. This is so close that the tori of the two bases intersect at *e*, and the bases and plinth *f* are usually cut from one piece of stone. The astragals *h* of each base will just clear each other nicely, and the tori *g* are the only moldings that interfere; but the top moldings *k* of the abacus will be intersected by the same moldings of the adjacent capital, and the two columns must be joined by a continuous abacus or the intercolumniation be increased as explained below.

**89.** In a colonnade where the Doric order is used and the columns are coupled, as *D* and *E* in Fig. 27, the greater intercolumniation must be aræostyle and the intercolumniation *d* between the coupled columns may be 25 parts or $\frac{5}{12}$ of a diameter, in order to prevent the intersection of the tori of the base. The axes of the columns are then carried up and made the center lines of the triglyphs $t'$. The triglyphs $t'$ are then each made 2 parts wider than their ordinary proportion, and the metope *m* is made 1 module and 18 parts in width.

These excesses cannot be discovered without very critical scrutiny, and are permissible as the only means of overcoming a great difficulty.

In the Ionic, Corinthian, and Composite orders, the deviation from the prescribed spacing, in order to insure axial centering of modillions, dentils, and other ornaments, is trifling, and in no case gives rise to any unusual difficulty. When coupled columns are used in either of these last named orders, their intercolumniation is generally 1 module, which is ample for projection of capitals and bases.

When there are modillions in the cornice, the intercolumniations must be so arranged that the axes of the columns and modillions will fall on the same line. If the modillions are 1 m. 10 p.* from axis to axis, the columns must be spaced under every fourth modillion to become $1\frac{2}{3}$ diameters apart, which is as near as we can come to pycnostyle. Under every fifth modillion they would be $2\frac{1}{3}$ diameters apart, or eustyle, and under every sixth modillion they would be 3 diameters apart, or diastyle, etc.

## PEDESTALS.

**90. Pedestals,** strictly speaking, should not be considered as a part of an order; but in designing a building there are so many cases where pedestals cannot be dispensed with that it is perhaps advisable to give them consideration in connection with the column and entablature of the order in which they are used.

Thus, within our churches and cathedrals, if the columns supporting the vault or roof rested immediately on the floor, the seats would hide their bases and a good part of their shafts; and in our theaters, courts of justice, and other public buildings, where crowds frequently assemble, the same thing would be true, and we would feel justified in raising our columns on pedestals in order to preserve the proper effect of our composition. Then, again, when it is desirable to run a balustrade between two columns, it is a most inartistic practice to run the railing into the shaft itself, and the pedestal, if placed under the column, would be a suitable height for the railing to spring from, and if it is not, it should be raised on a plinth until it is of proper height.

In the extravagances prevalent in the interior decorations of the Renaissance period, we find the pedestal used under the pilasters in the wall decoration, and the dado, or wainscot, carried around the room the height of the pedestal as a sort of continuous stylobate. The die of the pedestal is then occasionally decorated with tablets or with sunken panels, whose margins are molded; but such practices are to be indulged in only after careful study and mature deliberation.

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* *m.* and *p.* are abbreviations of the terms *modules* and *parts,* as explained in *Advanced Architectural Drawing.*

In each of the foregoing examples of the Roman orders, the proportions of the pedestal have been given in detail, and, as has been shown, the height of the pedestal is always exactly one-third the height of the column, including capital and base, while the entablature is always one-fourth that height. Suppose we have a monumental room the ceiling of which is 14 feet 3 inches high, and we desire to carry the entablature of an order around the side walls and support it on pilasters, at each side of each window and door, with as many intermediate pilasters as are required to give the whole an appearance of solidity; and we wish the pedestal to mark the height of the wainscot and the bottom of the sill of the window. Then the pedestal will be about 3 feet high, the column or pilaster 9 feet long, and the entablature 2 feet 3 inches deep. If 3 feet is not high enough for the wainscot, we would be justified in increasing the height of the pedestal by elevating it upon a plinth, or subbase, and decreasing the column and the entablature proportionately.

If, on the other hand, the ceiling is so high as to bring the pedestal above the desirable height for a wainscot, it is sometimes customary to have the cap of the wainscot a continuation of the astragal or necking of the pedestal, as is shown on the plates of the Corinthian and Composite orders.

## ARCADES AND COLONNADES.

**91.** An **arcade** is a series of arches supported either upon square piers with columns attached (as in the Colosseum, at Rome, a portion of the facade of which is shown in Fig. 28), or carried upon the piers or columns alone, as at *a* in Fig. 29, which is a view of Madison Square Garden, in New York City.

**92.** A **colonnade** is a series of columns connected usually by lintels, or beams, and when surrounding an open court is frequently referred to as a peristyle. The Madison Square Roof Garden is enclosed by a colonnade, shown at *b*, Fig. 29.

**93.** Where an arcade occurs in the facade of a building, as in Fig. 28, certain definite proportion must exist between the piers or columns supporting the superstructure and the superstructure itself. In the rule of this proportion, it will be found that the radius of the arch or the diameter of the opening is indirectly the governing measure of every detail of the arcade. In all such systems of colonnades and arcades two rules are to be observed: (1) *there must be an approximate equality of apparent mass between the weights and supports;* (2) *there must be a proportion of total void to total solid of about three to two.*

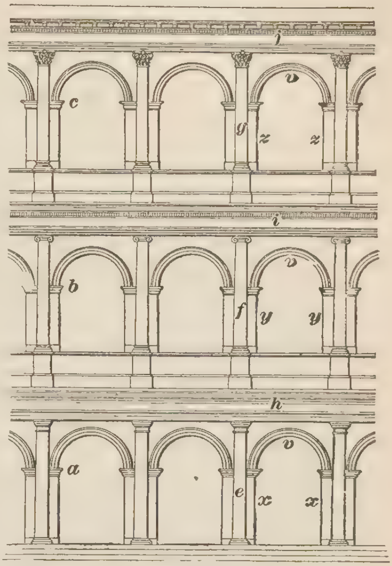

FIG. 28.

In explanation of this, let Fig. 30 represent an arch from an arcade in the facade of a building; then the portion $a\,c\,m\,f\,d\,c\,o\,b$ is the mass representing the weight, while $a\,g\,h\,b$ and $c\,i\,k\,d$ represent the supports. Now, according to the first rule, $a\,c\,m\,f\,d\,c\,o\,b$ should be equal to the sum of $a\,g\,h\,b$ and $c\,i\,k\,d$. The line $g\,k$ is divided into six parts, which serve as a scale to the diagram, the opening $h\,i$ being four of them, the height $h\,b$ is six, $n\,o$ measures two parts, and $o\,m$ one.

The surface of the weight $a\,e\,m\,f\,d\,c\,o\,b$ is equal to $(a\,e \times e\,f) - ($area of semicircle $b\,o\,c)$, which is equal to $(a\,e \times e\,f) - \frac{b\,c^2 \times .7854}{2}$, or in figures, $3 \times 6 - \frac{4 \times 4 \times .7854}{2} = 11.72$. The supports will be $(a\,b \times b\,h) + (c\,d \times c\,i)$, or in figures, $1\times6+1\times6=12$, thus showing a comparatively even division of mass between supports and weights. Now, if we compare the weights and supports with the void they surround, we have the rectangle $h\,b\,c\,i = h\,b \times h\,i$, or $6\times4 = 24$, and the semicircle $b\,o\,c = \dfrac{4\times4\times.7854}{2} = 6.28$, the entire void being $24+6.28 = 30.28$. The total area of the solid is then $11.72+12 = 23.72$, or fully two-thirds of the void as set forth in the second rule.

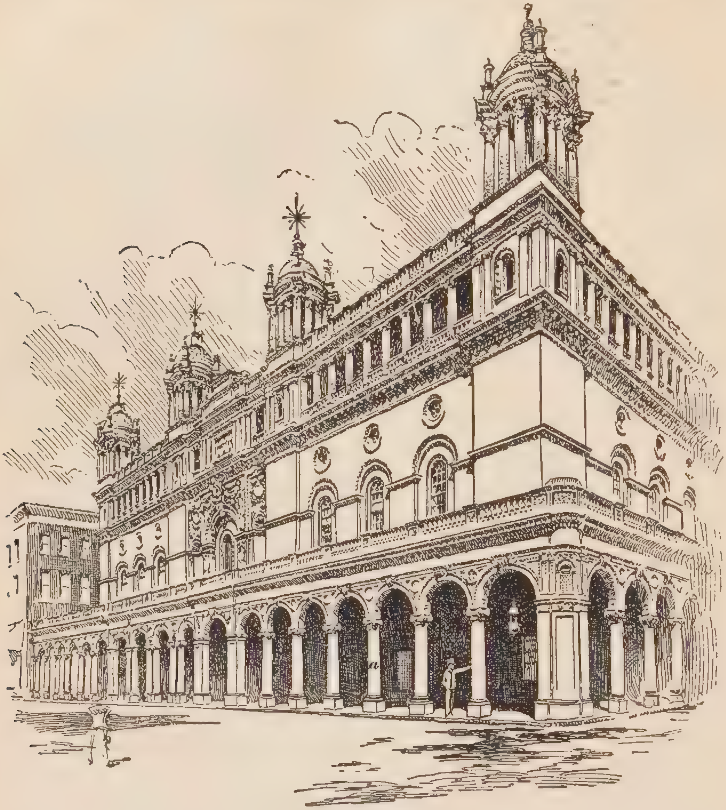

FIG. 29.

**94.** In Fig. 31, which is a portion of a Doric arcade, the area of the void $a\,b\,d\,c$ is 10.5 modules $\times$ 7 modules, or 73.5

square modules. The area of the semicircle $= \frac{(7^2\times.7854)}{2} = 19.24$, making the total void $= 73.5 + 19.24 = 92.74$. The area of the supports $= \frac{g\,h\,c\,a + b\,d\,j\,i}{2}$ $= \frac{3\times10\frac{1}{2}+3\times10\frac{1}{2}}{2} = 31\frac{1}{2}$, and the area of the rectangle $y\,x\,w\,z$ $-$ semicircle $a\,e\,b = (10\times5\frac{1}{2}) - \frac{7^2\times.7854}{2} = 35.76$, or total solid $= 67.26$; from this we see that the mass of the weight, 35.76, is very nearly equal to the mass of the supports, 31.5,

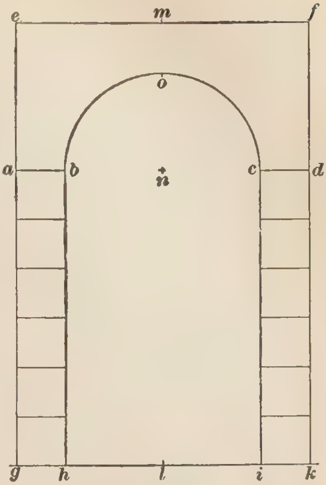

FIG. 30.

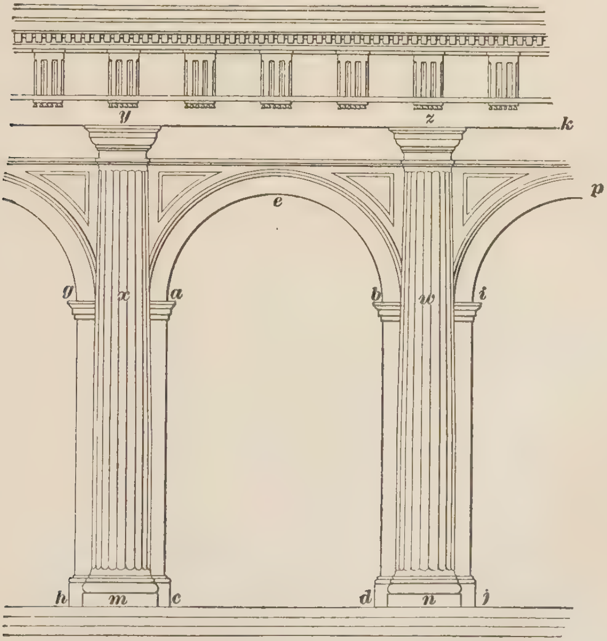

FIG. 31.

and that the sum of the weights and the supports, 67.26, is approximately two-thirds of the void, as required by the rules.

The entablature is not taken into consideration in making these calculations, as its apparent weight is carried by the columns $x$ and $w$, which are practically separate from the piers which carry the arch, and are considered separately as follows:

**95.** In a colonnade where there are no arches, but simply a continuous row of columns connected by lintels, we have to consider the lintel as the weight and the columns as the support. Let $q\,r$, Fig. 32, be the height of a column, and $s\,l$, the distance between the columns, equals one-third the height, or two diameters. Now, if we divide $q\,r$ into four equal parts at $a$, $b$, and $c$, and the horizontal lines $a\,d$, $b\,e$, and $c\,f$ be drawn, and also if $s\,l$ be divided into four equal parts at $g$, $h$, and $i$, and perpendicular lines be drawn through them, the *void* $y\,s\,l\,z$ will be divided into sixteen equal parallelograms, one-half of which, or eight parallelograms, will be equal to each of the two supports $q\,r\,s\,y$ and $z\,l\,k\,j$. But we should consider only one-half of each of these supports, as in a colonnade each support would have to carry one-half of two arches or lintels, and conversely each arch or lintel would rest on two half-columns; therefore, the semi-supports are $o\,m\,s\,y$ and $z\,l\,n\,p$, and their sum is equal to one-half of the void $y\,s\,l\,z$. We will now consider the lintel, or weight, $t\,o\,p\,u$ on the supports and equal to them in mass. Another row of parallelograms $v\,o\,p\,w$ is raised above the semi-supports, but this row contains but six parallelograms, while the supports contain eight; it is, therefore, necessary to increase the lintel, or

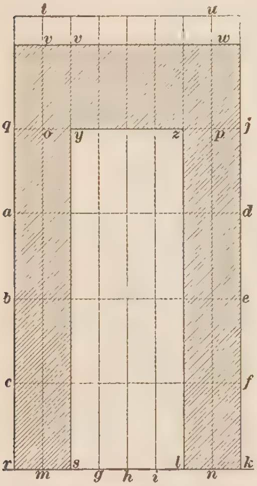

FIG. 32.

weight, in height till the area *t v w u* is equal to the area of two parallelograms. The increased height will be $\frac{2 \text{ parts}}{6}$, or one-third the height of one parallelogram. This will make the lintel, or weight, 1,333 parallelograms in height, or one-third the height of the column, which is the proportion of the entablature in the Grecian Doric, while one-fourth is the rule as laid down in the five Roman orders. The weights and supports are then equal, and their sum is two-thirds the area of the void.

The above proportions are for arcades and colonnades when they appear in the facade of a building as a part of the structure itself, as in Fig. 28; but, when the colonnade is simply used to support the roof of a loggia, or balcony, as in the Madison Square Roof Garden, Fig. 29, or as in the facade of the Louvre (Fig. 106, *History of Architecture*), the voids may be made much greater, and the design, if judiciously handled, will thereby assume a feeling of lightness which will be very pleasing.

Perrault, when he designed the colonnade of the Louvre, invented the intercolumniation above referred to as *aræostyle*, and in order to prevent the feeling of weakness that would appear in the facade of that structure, if there was but a single column at each point of support, he coupled his columns and gave to his structure that feeling of lightness combined with stability that makes the palace one of the most pleasing designs in the Renaissance style.

When the intervals between columns are increased beyond two and one-half diameters, the shaft of the column should be thickened beyond the proportions given for it under the rules for the orders, unless the columns are grouped in pairs as stated above.

**96.** A number of combinations of arches and square openings have been attempted by various architects to give variety to the effect of a long arcade, and though many of the designs are most ingenious, there is seldom a combination effected that is as imposing and dignified as the simple repetition of the arch and its supports, as shown in Fig. 29.

Fig. 33 is from a design by Vignola, for the Villa Borghese,

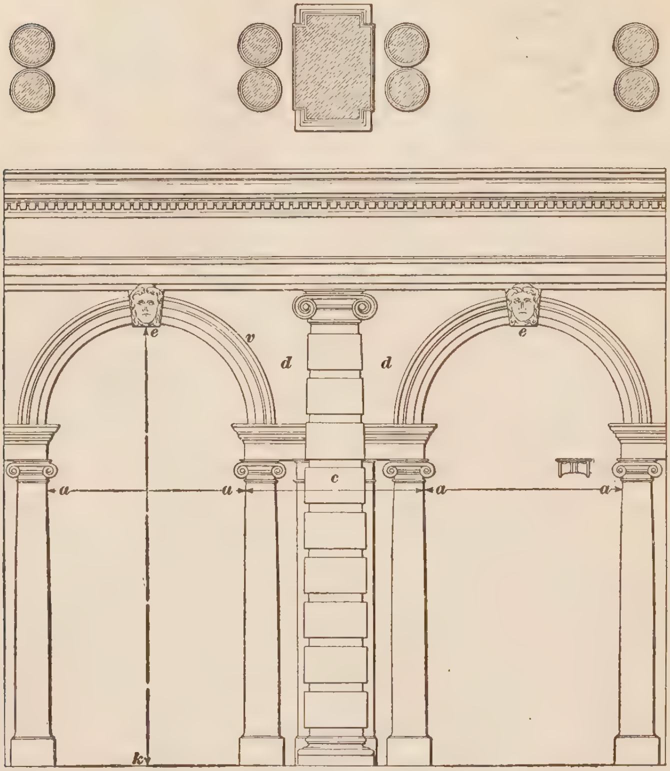

Fig. 33.

near Rome, and variations of it are much used in modern Renaissance work. The height *e k* of the arch is a little more than twice its width, while the breadth of the pier and columns *a*, *a* is a trifle less than that of the arch. A similar scheme in construction, but differing in the elements of its design, is shown in Fig. 34, which is from a basilica at Vicenza, designed by Palladio.

In either of these designs the weak point is at *a*, where the weight of the arch and superstructure is concentrated upon the tops of the columns, which have no lateral support except the column *b* in Fig. 34, or the pilaster *c* in Fig. 33. Unless very carefully provided against, the wall *d* is liable to bulge forwards and cause a collapse of the building.

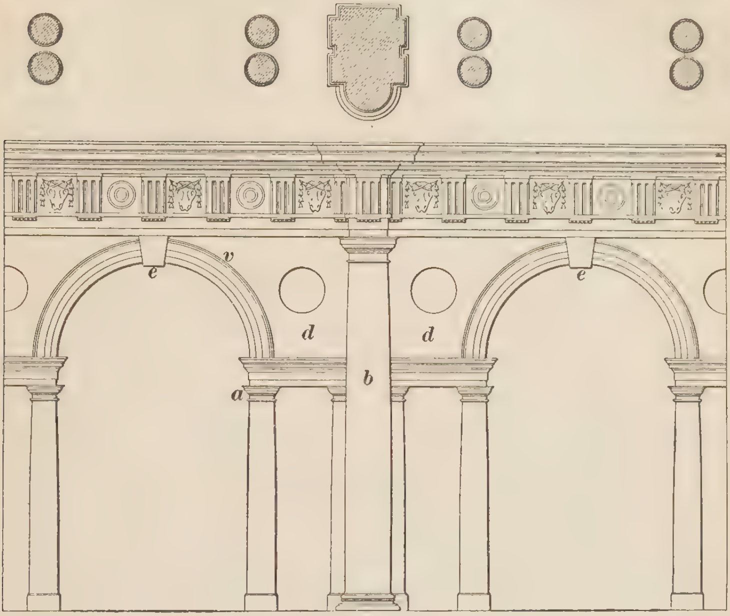

FIG. 34.

Far worse in this respect is the arrangement shown in Fig. 35, which, in various modified forms, is used repeatedly by both ancient and modern architects. In fact, its form was so much admired that we see it adopted as late as the eighteenth century, in much of the wood construction of the American colonial work. In this case the points *a* are so unstable that when the form is erected in stone, artificial means must be employed to anchor the angles at *a* back into the building and thus prevent the slightest bulging, which would be fatal. The width of the larger opening in Fig. 35 is four to six diameters of the column and about twice its width in height. The lesser opening is about two-thirds the larger one in width, and its height is governed by the length of the columns.

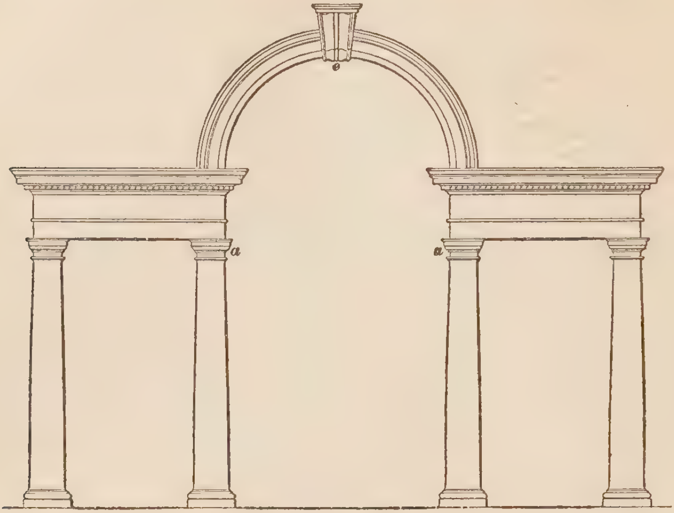

FIG. 35.

**97.** In addition to the specific rules above given regarding the proportioning of arcades according to equal weights and supports, the following proportions should be constantly borne in mind:

The height of the arch should be about twice its width. The width of the pier between the arches should not be less than one-half the width of the arch, nor more than the full width of the opening. The length of the small columns (where two orders are used, as in Figs. 33 and 34) should be about two-thirds the larger ones, and the width of the architrave *v* is equal to the top diameter of the small columns. The bottom of the keystone *e* is the same width.

## SUPERCOLUMNIATION.

**98.** **Supercolumniation** is the placing of one or more columns or colonnades above another. The idea originated with the Romans, but even with them it was sparingly used.

The principal advantage of the arrangement is that a building may thus be divided into stories, and the order in each story will be less bulky than if it ran up through three stories, as was done by Palladio in some of his palaces at Verona. A column or pilaster 30 feet high would thus require a shaft 3 or more feet in diameter, according to the order of the design; whereas, if the building were composed of two orders, as was Inigo Jones's Banqueting Hall, or of three stories, as is the Louvre Palace, the columns would be but 1 foot or more in diameter. The Renaissance architects appreciated this fact, and after a number of more or less experimental buildings, they deduced the rule that the base of the shaft of the superimposed column should be of the same diameter as the neck of the shaft of the column immediately below it.

The Roman builders arranged their supercolumniations on the principle that the apparent area of the upper column should be one-fourth less than the apparent area of the lower column, and that superimposed columns should be arranged from the bottom up in the sequence with which the orders are usually named, i. e., from Tuscan or Doric through the Corinthian or Composite. In other words, the Ionic can be placed above the Doric order, but under no circumstances should the Doric be placed above the Ionic. In following out this rule, we find that when we make the upper order or column one-fourth less in apparent area than the column next below it, the base of the shaft of the superimposed order will be of the same diameter as the neck of the shaft of the column below, and our rule as laid down first is the one most generally followed, as it is simpler and brings about the same results.

In the last two plates of *Advanced Architectural Drawing*, we have the Ionic and Corinthian orders so arranged that they can be placed one over the other and form a design of superimposed orders. The diameter of the base of the shaft of the column in the last plate is the same as the diameter of the neck of the shaft in the previous plate.

## PILASTERS.

**99. Pilasters** are square engaged columns or projections from the face of a wall, to carry a girder or the abutment of an arch, and they are designed in the same proportion of length to width as are the columns of the order in which they are used. The most common base is the form known as the *Attic base*, or a plain fillet and torus, as at *a*, Figs. 36 and 37, but the capitals differ widely even when they are used in connection with one or more columns of the five orders. Occasionally, the capital will be a modified form of the proper classic capital of the order in which the pilaster is used, but more often it is a series of plain moldings, more or less enriched according to the character of the edifice in which it is used. The moldings of the Tuscan and Doric capitals can be used very appropriately on a square pilaster as shown at *c*, Figs. 36 and 37, but the Ionic and Corinthian capitals have never been successfully transferred from the round column,

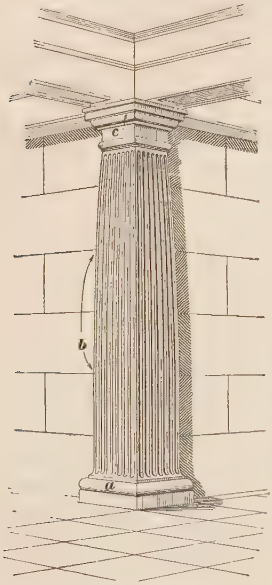

FIG. 36.

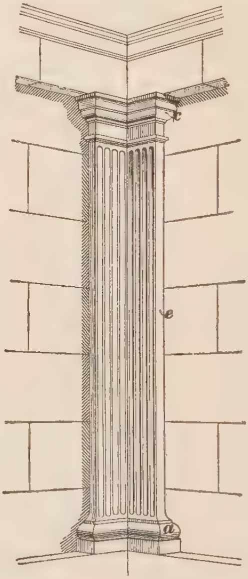

FIG. 37.

When a pilaster is used to support the wall end of an entablature whose outer extremity rests on a column, the sides of the pilaster diminish with entasis in the same manner as do the sides of the column, as shown at *b*, Fig. 36; but when no column is present, the pilaster is straight and its sides are parallel and perpendicular to the base, as shown in Fig. 37.

**100.** Pilasters should project from the face of the wall in proportion to the work they have to perform; those designed to carry lintels or arches project from one-half to two-thirds their widths, while others, as referred to in Renaissance work, which simply perform the functions of dividing a wall into panels, need stand out but one-quarter, or even one-fifth, their width.

In the Pantheon, at Rome (see Fig. 32, *History of Architecture*), the pilasters forming the ends of the walls between the niches projected but one-fourth of their diameter. But as these columns and pilasters were nearly 40 feet high, this small proportionate projection was quite sufficient to define their outline, which was all the occasion required. Pilasters are made plain, fluted, or paneled, according to their material and to the surrounding circumstances. In the portico of the Pantheon the columns were left plain and the pilasters were fluted. The cause of this is evident, as the columns were of granite and the pilasters of marble; the former material is very difficult to cut, while the latter is easily worked.

When pilasters are fluted, either seven or nine grooves should be the number, according to the practice of the ancients, except where a pilaster is returned on the angle of an inside corner, as in Fig. 37, in which case four or five should be cut on each half to avoid bringing a flute into the angle. When a pilaster is returned on an exterior corner, a full-width face is shown each side of the angle, as shown in Fig. 36. When pilasters project less than half their diameter, their return faces are not fluted, as shown at *c*, Fig. 37.

## IMPOSTS.

**101.** Another supporting detail used with the orders is the **impost**, which, though somewhat akin to the pilaster, is entirely different from it, and is used only in connection with arcades. In Fig. 31 is a portion of a Doric arcade, where the entablature *y z k* is supported upon the columns *y m* and *z n*, and the arches *a e b* and *i p* are carried by the *imposts g*, *a*, *b*, and *i*. An impost, therefore, is a group of moldings at the top of a pier or pilaster, to receive the abutments of an arch.

In classic architecture these impost moldings were differently grouped in the different orders, and were measured in terms of the module of the order in which they were grouped; Figs. 38 to 42 show these moldings as they were grouped in each of the orders, and the proportions of each one in terms of the module of its order. In classic structures, and also in most of the Italian Renaissance edifices, the piers and moldings of the facade are proportioned in the terms of the module of the order used in its erection. There may be neither columns nor pilasters in the facade, but the cornice is proportioned as though there was a complete order in the composition; and, if a series of arches constitute one story of the facade, their imposts are molded in the terms of the order which governs the arcade.

Fig. 38 is the impost used in the Tuscan order, and is as

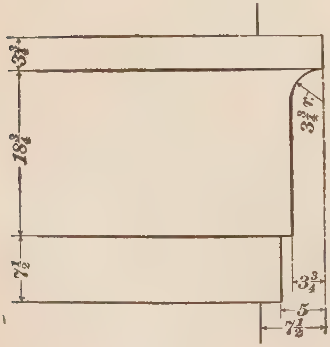

Fig. 38.

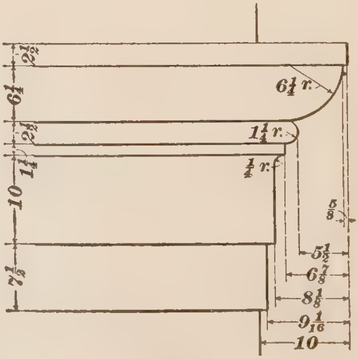

Fig. 39.

simple and severe as are the other details of that order. Fig. 39 is the impost corresponding to the Doric order, and

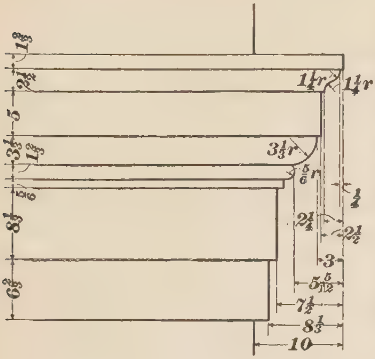

FIG. 40.

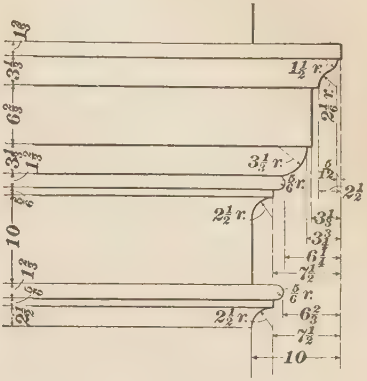

FIG. 41.

though consisting of more members than the former, it is still very simple and unpretentious. Fig. 40 the Ionic, Fig. 41 the Corinthian, and Fig. 42 the Composite, imposts, are much more elaborate than the Tuscan and Doric, and vary one from the other only in a slight degree, as is shown by the figures giving their proportions. However, each should be used only in connection with the order to which it is attached, as these lines of molding were adopted by the ancients only after mature deliberation as to what was best suited to the style. Fig. 28 shows the Doric, Ionic, and Corinthian orders superimposed in the facade of the Colosseum, and at *a*, *b*, and *c* are the imposts of each order, as distinct from one another as the orders themselves.

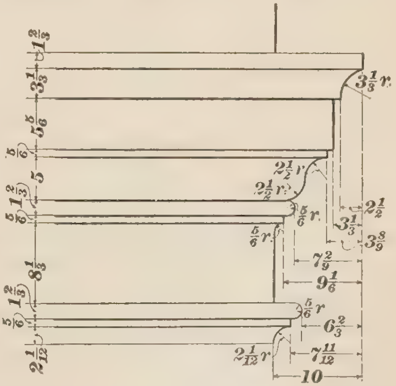

FIG. 42.

## BALUSTERS.

**102.** A **baluster** is a species of column used to support a cap rail or hand rail, and is part of an ornamental railing placed in front of windows, or on the sides of stairways, enclosures for balconies, etc.; its primary purpose is to protect the occupants from accidents. A balustrade is essentially a series of balusters with base rails and cap rails and may be placed between columnar pedestals or have independent angle and intermediate piers to strengthen the construction, and should always partake of the general characteristics of the edifice of which it forms a part.

The general rules to be observed in designing a balustrade are that the balusters should be odd in number, and the distance between them should be equal to half their larger diameter, from which will result an approximate equality between the open and solid spaces. The whole height of the balustrade should be divided into thirteen equal parts, of which the height of the baluster is eight parts, *a*, Fig. 43, that of the base *b* is three parts, and of the cornice, or rail, *c* is two parts. Balustrades intended for actual use in a building, such as balusters used on stairs, before windows, or enclosing terraces, should not be less than 3 feet nor more than 3 feet 6 inches in height, but when used merely for ornamental purposes, as in crowning an entablature on a building, the balustrade should bear some proportion to the parts of the building. It should never exceed four-fifths of the height of the entablature on which it is placed, and it should be placed upon a plinth, if necessary, to raise it so that the entire balustrade can be seen from the best point of view for the building itself; and in such a case the balustrade must not be less than two-thirds the height of the cornice. When a balustrade fills in between two pedestals,

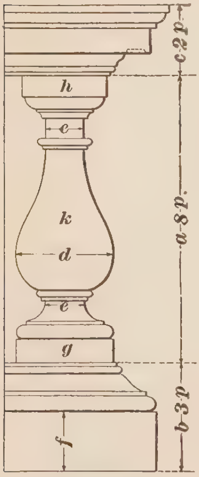

FIG. 43.

its height, of course, is regulated by the height of the pedestal, as is explained in connection with the dado, and all rules governing the proportions of pedestal and wainscot will apply equally to the balustrade, where it is employed in the same situation.

**103.** The baluster varies in shape and proportion of thickness to length of shaft, according to the order in which it is used. Unlike the column, it has practically no weight to support, and its bulk is only varied to make it conform with the order wherein it exists. The two last plates of *Advanced Architectural Drawing* show two examples of balusters, wherein the general outline of the one in the last plate is similar to the one in the previous plate, but doubled and placed with the two bases butted together in the middle. The plinth *g* and abacus *h* of a baluster (Fig. 43) are always square, and the shaft, or, as it is sometimes called, the *vase k*, is nearly always round; sometimes, in the Tuscan order, the vase is made square also, but only when the Tuscan is used in its rustic form and the column is built of alternating square and round courses.

The thickness of the baluster *d* at the heaviest part of the vase is, in the Tuscan, equal to three of the thirteen parts into which the whole height of the balustrade is divided, and in each of the other orders it is less, but varies according to its position and the service for which it is employed, whether useful or ornamental. At *e*, the slender portion of the baluster, the thickness should never be less than one part and seldom much more. The width of the plinth *g* is equal to the diameter of the vase at *d*, but the width of the abacus *h* should be about one-seventh less.

## DOORS AND WINDOWS.

**104.** The arrangement of the doors relative to each other and to the various internal passages of a house is discussed elsewhere, and we will confine ourselves here to the discussion of doors and windows with reference to their relative proportions. There is no fixed proportion for window openings, their sizes depending almost entirely upon the climate and clearness of the sky likely to prevail in the country where they exist. In the hot southern countries of Europe and America the windows are small and few, whereas, as we come north, we observe an increase of size and number as the days grow shorter and the sun is less glaring and objectionable. Therefore, the size of windows will depend entirely upon the architect's idea of what is best adapted for the position and locality.

It is very important that the exterior grouping of windows should be well considered; for, while it is not necessary that the two sides of an elevation should be absolutely symmetrical, it is desirable to have each window show for itself just why it is placed in its particular position. The windows in an elevation are the keys to the interior arrangement of the house, and their treatment and decoration should not be such as would lead an outsider to take the sash on a stair landing for a window of a parlor or library. In Renaissance work it is customary to treat the windows with columns or pilasters, as in the Farnese Palace shown in Fig. 94, *History of Architecture*, but great care must be exercised in this, as the order, if introduced in too heavy proportions, will render the facade clumsy in composition.

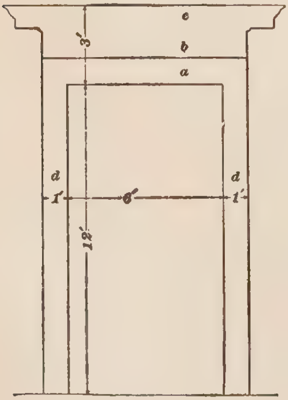

FIG. 44.

**105.** Architecture does not depend on arbitrary laws, and the rules laid down by the ancients were such that, in the best periods of art, they not only prevented the artists from falling on either side to excess, but gave them full liberty to use their talent and inventive genius to the fullest extent. In Fig. 44 we have the outline of a door with its architrave *a d*, frieze *b*, and cornice *c*. Its proportions correspond with those usually adopted; that is, its height is twice its width, and the entablature is one-fourth the height of the opening, and the architraves *d* on each side are each one-sixth of the width. The opening, therefore, measured in terms of the width of the architrave, is 6 parts wide and 12 parts high, and its area is, consequently, 72 parts. Now, it will be found that the solid parts are exactly two-thirds of this area, thus showing the analogy between the columns and the entablature of an arcade, and the architrave and cornice of a door opening, and the reason for the definite proportions of parts in the details of the door and trim. All gates and doors must, independent of all other considerations, be of sufficient size for convenient passage through them; hence, internal doors should never be reduced below 2 feet 6 inches in width, and 6 feet 8 inches in height. Three feet is a good width for an inside door, and its proportionate architrave would then be 6 inches. Therefore, on all inside doors approaching this width it is customary to design a 6-inch trim throughout the house. But on a monumental doorway 6 feet wide and 12 feet high, we would require a full 12-inch architrave, as shown in Fig. 44. These are minimum dimensions for ordinary houses, but for more pretentious dwellings and for state apartments in mansions and hotels, widths of 4 to 6 feet, with folding doors, etc. of proportionate heights, will be nearer the appropriate sizes.

## MEDIEVAL PROPORTION.

**106.** We will now consider a style of architecture entirely different from every principle and proportion which we studied in the classic orders. Gothic architecture bears not the slightest resemblance to anything which preceded it; but, like the Egyptian and Greek in one respect, it is absolutely original. The builders of the middle ages invented methods and systems, and did not take them by inheritance from their ancestors, as the Romans did, nor dig them from the débris of antiquity, as the Renaissance architects did. During the transitional, or Romanesque, period, already described, the guilds of freemasons increased in strength and power until the building of the great cathedrals was entrusted to their hands entirely.

The formation of a secret society for masons and craftsmen was found necessary, in order that duly qualified artisans might secure work in strange cities, to the exclusion of incompetent impostors. The schools of artisans established by the church were open to all believers in the true faith, and, having served their apprenticeship under the tuition of the most experienced builders, the artisan or craftsman started out in the world to some cathedral-building city or monastery, and applied for work. Certain secret signs and passwords were all that were necessary to inform his new master how far he had progressed in his trade and to what grade of work he was best fitted. The more expert he became with his tools, the higher he was advanced in the masonic order, and as each degree of advancement had a different password, he could enter another district and secure work on another ecclesiastical edifice at exactly the same grade where he left off. Masonry thus became a powerful secret order, and the discoveries made in details of design and construction remained secrets with the craft. Many of these secrets were lost when the extensive building operations of the fifteenth and sixteenth centuries demanded more masons than the guilds could produce, and the constant employment of outside men uprooted the necessity of freemasonry, and the organization apparently died out. Among these lost secrets were the principles of the proportioning of the medieval cathedrals and abbeys, and the system of contouring the Gothic moldings—a system, of the existence of which ample proof exists, as there are many cases of duplicates of archivolt moldings, as much alike as though they were executed from the same drawing, though the two similar examples are as far separated as France and Scotland.

Modern research has succeeded in unearthing a portion of these methods. It has been demonstrated, and is accepted now, that certain combinations of the circle, triangle, and square are the fundamental principles of the proportion of not only medieval moldings, but also of the cathedrals, abbeys, monasteries, and structures of every class and kind built during the Gothic period.

**107.** In order to better understand these principles of medieval proportion, it will be necessary to consider for a moment the system under which these enormous buildings were erected.

Architects, as such, did not exist in those days, and the plans for our great cathedrals were never drawn out in detail as in working drawings. The bishop or other ecclesiastic in charge of the building operations simply furnished an idea of the size and location of the desired edifice. He was a master mason himself, and perfectly capable of superintending all the details of construction, but each individual workman had full charge of his own particular work, and continued at it until his task was completed. Each mason understood perfectly all the complications of geometry necessary to cut his arch stones properly, and did his work so well that there are few cases known in all the medieval cathedrals where the work failed to fit or to come out properly.

**108.** The proportion of length, breadth, and height was often determined by a relation involving a combination of the square, triangle, and circle, and the square and its diagonal; the cube and its sides appear also to have furnished a unit of measurement in a similar manner. The development of the surface of a cube, according to the rules of descriptive geometry, produces the figure of a Latin cross, as shown in Fig. 45, which is the general form of all our medieval cathedrals. The so called magic numbers, which were used

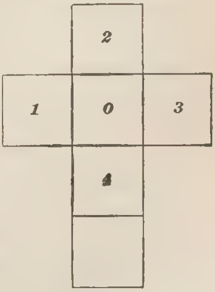

FIG. 45.

as a unit upon which to base the proportions of these great edifices, were probably 3, 5, and 7.

The first of these is exemplified in the crucial form, Fig. 45, by the three squares forming the apse and the two transepts; the second number is exemplified in the five squares forming the entire crucial figure with the exception of the central or inside square *0*, and the third number is acquired by counting the squares in each direction.

Winchester Cathedral, Fig. 76, *History of Architecture*, exhibits the existence of these figures, as applied to the proportioning of its plan, much more practically than explained above. The extreme length of the church, exclusive of the lady chapel, is five times the width. The transept is in length a trifle less than five times its width, while the projection of the transept from the walls of the nave is one-seventh of the total length of the nave. The height of the nave is one-seventh its length, and, if divided into fifteen parts, seven are given to the lower arches, three to the triforium, and five to the clerestory.

Thus we see that there is little doubt that the three above mentioned numbers had a strong influence in the proportioning of many of these cathedrals, as many other instances can be cited where the same apparent rules will apply.

**109.** The nave of Amiens Cathedral, in France, is proportioned somewhat differently, but none the less on geometric rules. Fig. 46 is a diagram showing the nave of the cathedral as standing within a cube *a b c d e f*. Each face of the cube is divided into thirty-six equal squares, and the bases of the nave piers *g* are placed at the intersections of the lines forming these squares on the under side, or base, of the cube. The height of the piers will then be two squares *g h*, the pointed arches will extend one square higher *h i*, the triforium will then occupy one line of squares *i j* above the arches, and the clerestory will take the two remaining squares *j k* to the top. Observe, also, that the width of the aisle *g l* back of the nave arches is equal to just one square, and that the thickness of the wall and buttress *l f* and *l e* is one square more. The exactness with which this result is attained leaves but the slightest possible doubt that Amiens Cathedral was proportioned on the principle of the cube, and

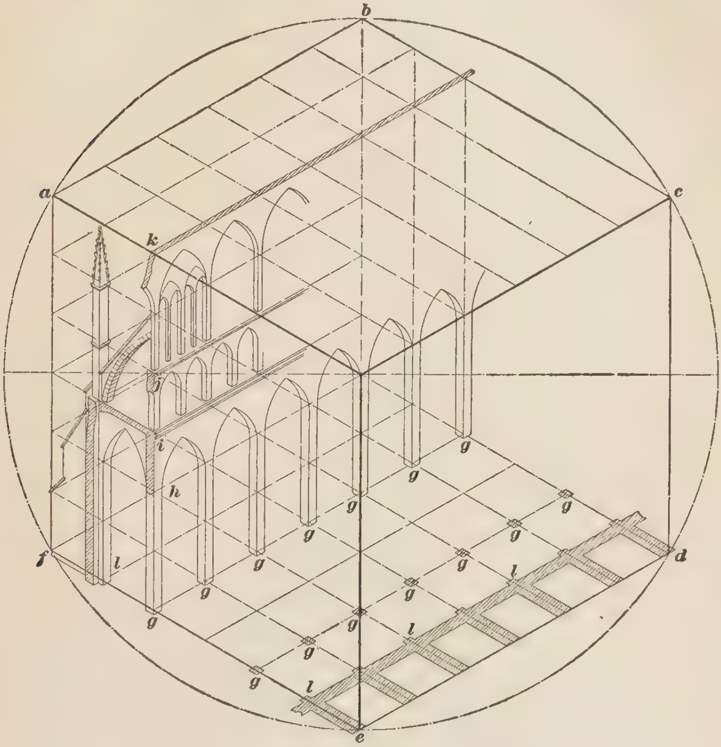

FIG. 46.

we shall see as we proceed further that the details of the molding, windows, tracery, groinings, etc. are all governed by some unseen law in geometry.

**110.** In Great Britain the heights of the vaults seem to have been determined upon a system of triangles. Salisbury, Worcester, Litchfield, York, Hereford, and a number of other cathedrals were probably vaulted upon the system shown in Fig. 47. Upon a given line *c a b* distances are laid off to the right and left of the center *a*, equal to the distances of the piers of the vaults from the center line of the nave *A*, and equilateral triangles are then erected with these points limiting their bases. The apex of each of these equilateral triangles will then mark the height of a vault. In Fig. 47, *a d*, *a f*, and *a g* represent the distances of the nave columns *h*, the aisle columns *i*, and the wall *j* from the center line *a* of the nave *A*. Now, if we make *a m* equal to *a g* and erect an equilateral triangle *m o g*, we will have the apex of this triangle *o* for the crown of the vault over the nave *A*. The apex *s* of the equilateral triangle *a s g* marks the height of the aisle vault *B*, and the apex *t* of the triangle *d t g* marks the height of the vault *C*.

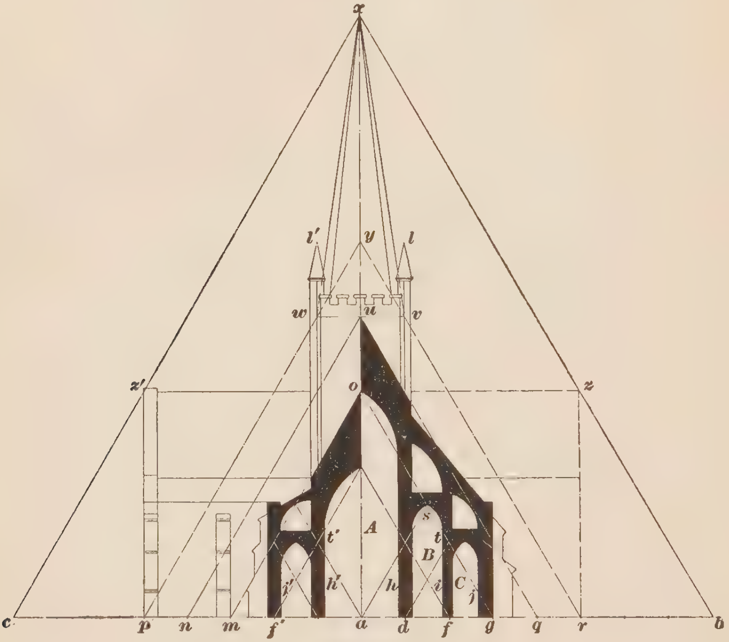

Fig. 47.

On the right side of the center line *x a*, this diagram defines the governing points for a five-aisle church, and, upon the left side, the same arrangement for a three-aisle church.

The tower and spire *v w x* are for the three-aisle half of the plan where the equilateral triangle *n u q* marks the height of the tower roof, when its base *n q* is equal to twice the width of the church. The apex *y* of the triangle *v u y* determines the height of the pinnacles *l* and *l′*, and the sides *y w* and *y v* if prolonged will intersect the base line at *p* and *r*, or at a distance equal to *a d*, from *n* and *q*. If the transept *z z′* is extended to this point and another equilateral triangle *b x c* be constructed so that its sides touch the gable points *z* and *z′* of the transept, then the apex *x* will mark a desirable height for the spire.

The idea here is not to give the student a regular system to measure and draw Gothic details, as was done with the classic work, for that system has never been discovered, but enough has been proved, as is described above, to show that such a system existed, and that these noble monuments of the dark ages were not the results of guesswork. Therefore, in designing a small church or a big cathedral, the architect of todayhas the same task before him, and his first move should be to develop a system on which his work can be carried forward.

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## WINDOW TRACERY.

**111.** In *History of Architecture*, window tracery is discussed briefly with regard to its value as a key to the date of the building, or the period of the architectural style. We will now consider its constructive features and the elements of its composition. The circle, square, and triangle form the basis of all tracery designs in the early English period, but the pentagon, hexagon, octagon, and

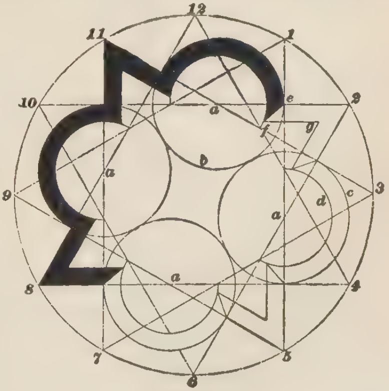

FIG. 48.

other polygonal forms each played a part as the style advanced.

**112.** In one of the window heads of the cloisters at Westminster Abbey, the date of which is about 1348, we find two figures that resemble the plans given to clustered columns, indicating that the same principles were applied to setting out both windows and points of support. When the circumference of a circle, Fig. 48, is divided into twelve equal parts, the dividing points form the apexes *1*, *2*, *3*, *4*, etc. of four equilateral triangles, and we have at their intersection *a*, not only the centers of the circles *e b* that are to constitute the form of the filling-in, but also the necessary miters *e f* and other parts of the figure; the width of the bar is *c d*, and all bars are drawn parallel to the construction lines.

The heavy black outline shows the design of the above mentioned window head, and comparison with Fig. 66 exhibits the close resemblance of this outline to that of the pier plan of the same period.

These geometrical rules were evidently applied to windows and to tracery of every description executed at the end of the thirteenth or the beginning of the fourteenth century; also, to the plans of the main clustered pillars in many churches and cathedrals.

**113.** For over a century, circles and their intersections formed the ornamental portions of every kind of panel as well as window head; they were afterwards blended into other figures, and apparently set out upon different principles, but the hexagon and equilateral triangle were necessary to produce the flowing lines which succeeded. The change which took place in design arose from the facility which had been attained by the practice of this method, and is ample evidence of the inventive power of the freemasons, and the progressive improvement in their school for depicting form. Windows are divided into two, three, or four *days*, as the openings for the admission of light are called, in distinction from the *mullions*, or solid bars, which separate them; and the upper portion, when enclosed in an equilateral triangle, furnished opportunities for the production of designs of unlimited variety and singular beauty. In the more simple examples, there are three days, or lower divisions, as shown in Fig. 49, and the head is occupied by three circles *t m n*, *e h i*, and *h n l*, each of which contains a trefoil or a quarterfoil. *a*, *b*, *c*, *d* are the centers from which the side arches, as *c f d*, are described; *u* indicates the position of the centers for the central arch, whose apex is at *v*; *p* and *q* are the centers for the main arch *p o q*; *g*, *k*, *j* are the centers of the three circles; *s* is the center for the transition curve *i r*; the curve *c f* is described from the center *c*. In the highest development of the early

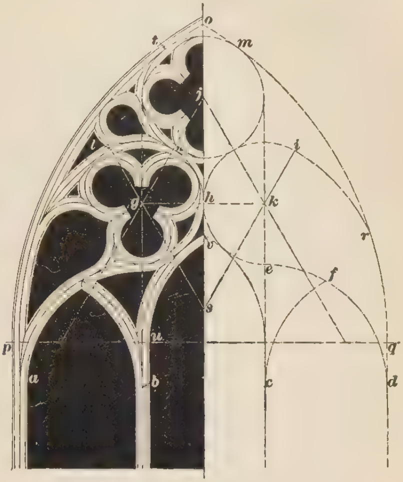

FIG. 49.

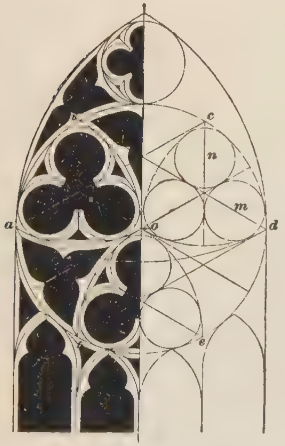

FIG. 50.

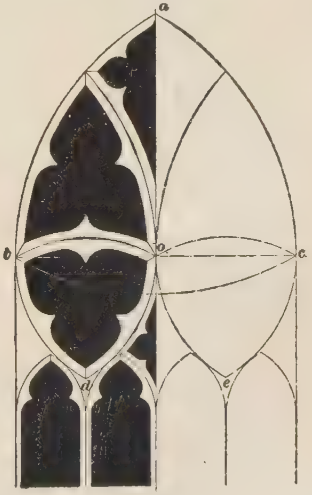

FIG. 51.

English period, these lines of tracery were as free and capricious as the running vine, but they were all constructed on geometrical principles, and the lines which tended to confine or stiffen the design were omitted.

**114.** Windows of four days, Fig. 50, are sometimes constructed with one large circle in the head *a b c d e f* divided into three equilateral triangles *a o b*, *o d c*, and *f e o*, each enclosing a trefoil *m n o*; or sometimes the head consists of one equilateral triangle *a b c*, Fig. 51, with two smaller ones *b o d* and *o c e*, constructed on the points of its base *b* and *c* and dropping into the spaces *d* and *e*, comprised between the heads of the divisions below.

**115.** Windows of six days are far more complicated, but, though exhibiting greater skill in geometry, they are set out precisely upon the same principle. Two equilateral triangles *a b c* and *d e f*, Fig. 52, enclosed within the great circle in the window head *a e b d c f*, mark out the prominent features of the design, and their terminations *a*, *f*, *c*, *d*, *b*, and *e* are the apexes of the spherical triangles *e g h*, *d i l*, *b k j*, etc., which by their crossings constitute the filling-in.

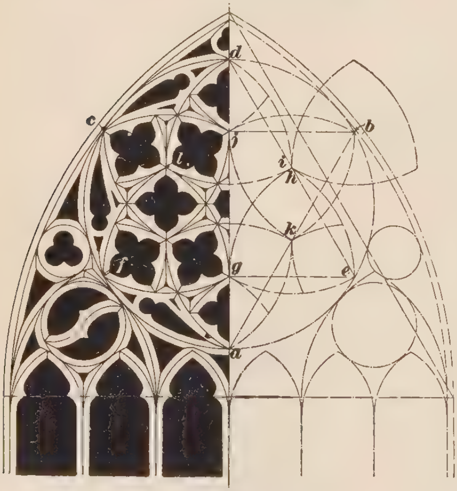

FIG. 52.

In some examples, above the two main lower divisions of the window, *a b c* and *d c e*, Fig. 53, a circle whose center is at *o* and whose diameter is equal to half the width of the window, is drawn, and its circumference is divided into twelve parts, *1*, *2*, *3*, *4*, *5*, etc.; and smaller circles, tangent to one another and to the circumference of the great circle on its interior, are described in each.

At the close of the fourteenth century, these designs were so numerous that almost every cathedral and church had its own peculiar windows, but the general principles of setting out the work are identically the same everywhere. The circle and the equilateral triangle were subdivided almost to infinity, and at no time during the entire history of the arts do the mental faculties of the people seem so fertile as at the close of the fourteenth century, which we are now considering.

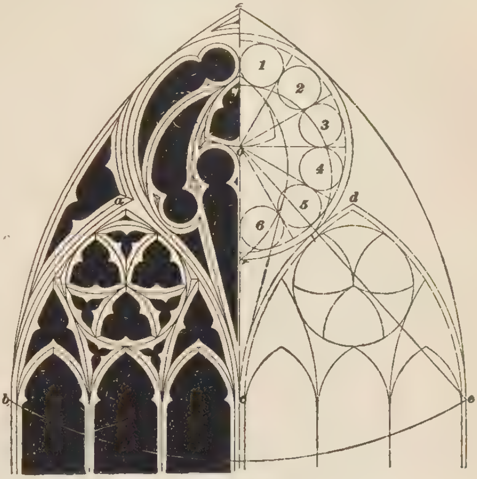

FIG. 53.

**116.** The form and magnitude of the several mullions used to divide these windows into days were also determined by means of the equilateral triangle. A line drawn from the apex of one mullion *a*, Fig. 54, to the apex of the other mullion *b*, forms the base of an equilateral triangle *a b c*, about which is drawn the hexagon *a d c e b f*, and with *d e* as a base another equilateral triangle *d e f* is drawn within the hexagon. The interior hexagon *g h i j k l* is then divided into six

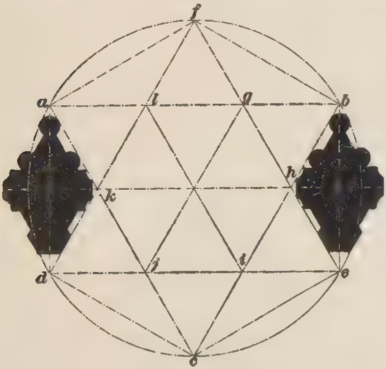

FIG. 54.

triangles, each one of which is equal to the area of half a mullion, and the lozenge shape which two of these triangles form when placed back to back is the outline enclosing the moldings of the mullion bar of the window. Of the twelve equilateral triangles embracing the two half mullions, ten are given to the day, or space to admit the light, and two, or one-sixth the whole, are given to the mullion. This is very nearly the proportion observed in all cases throughout the middle ages.

**117.** The pointed arch, as has been said before, was the direct development of efforts of the Romanesque builders to build permanently with the materials they had at their disposal. Notice how in the earliest stages of this struggle for stability, there was no attempt to produce elaborate ornament, but, on the contrary, every effort of mind and might seemed concentrated upon the desire to build permanently; and it was only after this desire had been satisfied and its purpose had been accomplished, that the architects, freed from this struggle and uncertainty, allowed their thoughts and inventive genius to run in lighter channels and convert every form in nature, with which their God had blessed the earth, into an ornamental figure for the embellishment of their new construction. The once stern, cubical capitals now become light and lively with animal and vegetable forms; running vines, bunches of flowers, leaves, fruits, and even dry branches, formed parts of the designs taken from the vegetable world, while beasts, birds, fishes, and reptiles were freely imitated in many of their carvings. Early Gothic architecture thereby was simply an ornamented construction, and every groin, capital, column, or buttress was built in its place because its presence was absolutely necessary, and never simply to look pretty. The same ideas should be observed in designing a Gothic structure in the present day. Construct the building to stand, proportion its parts to stay, pierce the walls where necessary, and then, but not till then, let the ornamentation be considered.

## MEDIEVAL DETAILS.

### ARCHES.

**118.** At the end of the twelfth century and in the beginning of the thirteenth, the first condition in order to arrange the plan of an edifice was to know whether it was to be vaulted, and, if so, in what way. It was then necessary, as soon as the number and directions of these vaults were determined, to make drawings of their bases which rested upon the capitals of the columns; for the outline of these base blocks determined the shape and dimension of the abacus and capitals, as well as the number, sizes, and positions of the vertical supports. This method of working will at first seem strange, as it appears to be deriving the ground plan of the building from the design of the roof or vault, but it is perfectly rational. The medieval builders wished to cover a surface, and to do it they proposed to fix vaults upon points of support; therefore, the principal object was the *vault*, and the points of support were only the means of holding it in place,

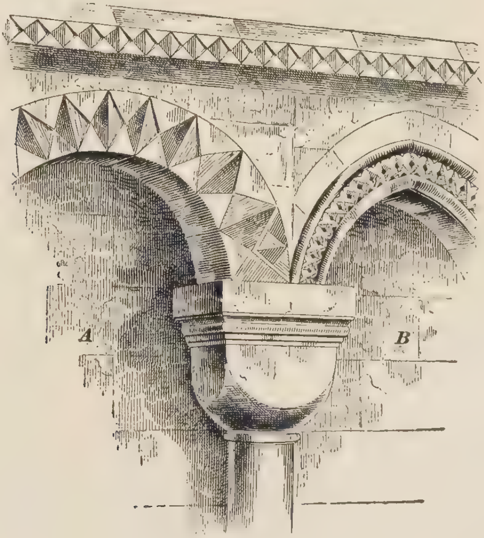

FIG. 55.

and their position on the plan could be changed only through a change in the form of the vault itself.

Medieval arches and vaults, as has been shown, are different in kind, different in principle, and different in construction from those we have seen in the Roman structures, and all these points of difference are the results of attempts to overcome difficulties; therefore, it is not at all surprising to find them enriched by an entirely different system and style of ornament.

**119.** The early Romanesque arch was semicircular and absolutely plain, except in a few places where a *chevron* or dog-tooth ornament was cut in with an ax. As the style advanced, and the pointed arch came into use, the carved work became finer, owing to the use of the chisel instead of the clumsy ax, as shown in Fig. 55, which is a part of an arcade at Canterbury Cathedral. Here the old work as hewn with an ax is seen on the side marked *A*, and the new work, after the chisel had superseded the ax and the pointed arch had taken the place of the semicircular one, is shown on the side marked *B*.

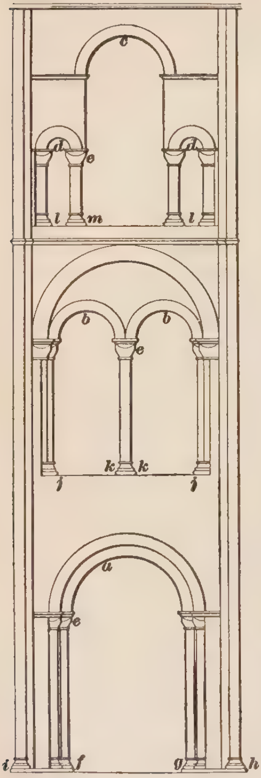

Fig. 56.

**120.** Fig. 56 shows one bay of the transept of Winchester Cathedral as it was originally erected by its Norman builders in the year 1076. The absolute plainness of the arches, capitals, and columns shows more plainly than words that the desire to produce superficial beauty was entirely subordinated to the endeavor to build permanently and substantially.

No moldings of any kind grace the arches, and no carvings enrich the capitals *e*, but a judicious grouping of arches at *a*, *b*, *c*, and *d* shows us that they understood the value of graceful proportions and the importance of variety in outline. The arch over *f g* of the nave is as broad as they could safely make it and leave the piers *i f* and *g h* large enough to carry the heavy superstructure and proposed vaulting; but the arched openings *j k* in the *triforium*, or gallery, are divided to give variety, and at the same time are sufficiently broad to admit light to the triforium from the nave, while the openings *l* and *m* in the clerestory were comparatively small, as they were high above the roof of the triforium or any other interference and admitted light directly to the nave from the outside of the building. Permanent scientific construction was the governing principle in all this early medieval work, and no attempt was made to embellish its details until after this was assured.

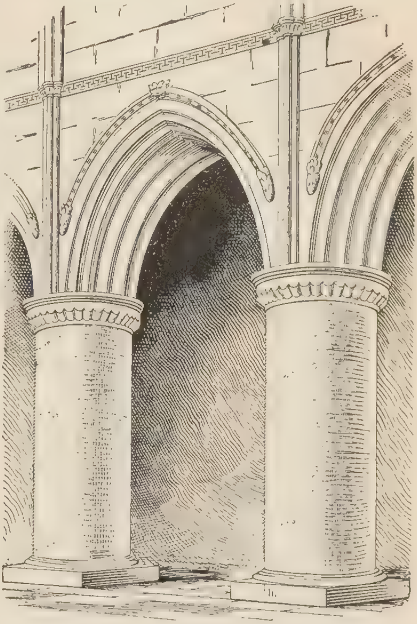

FIG. 57.

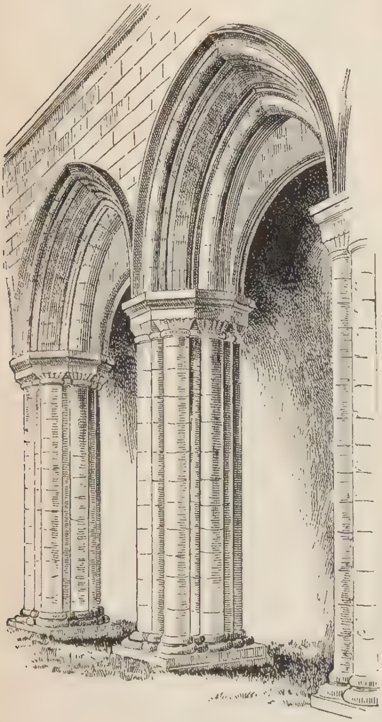

FIG. 58.

**121.** Though some of these early Norman arches were molded as explained above, fully as many were left absolutely plain; but, as we approach the early English period, the arches are deeply molded and richly carved. These moldings were not cut before the stone was put in the building, as is done with most modern work, but the stone was corbeled out, one course over another, and the projecting edges were then chamfered and cut into the molded surface as explained under the head of Gothic moldings.

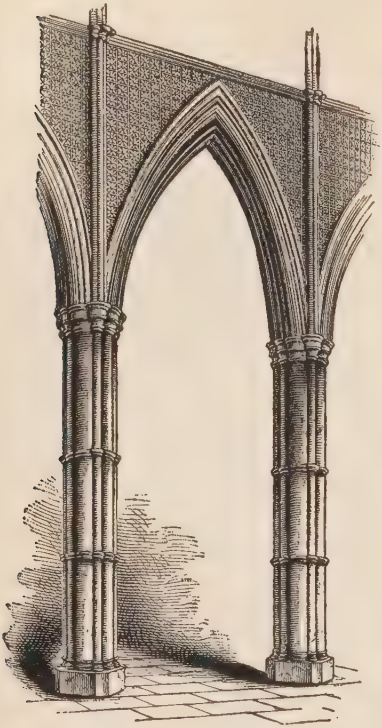

FIG. 59.

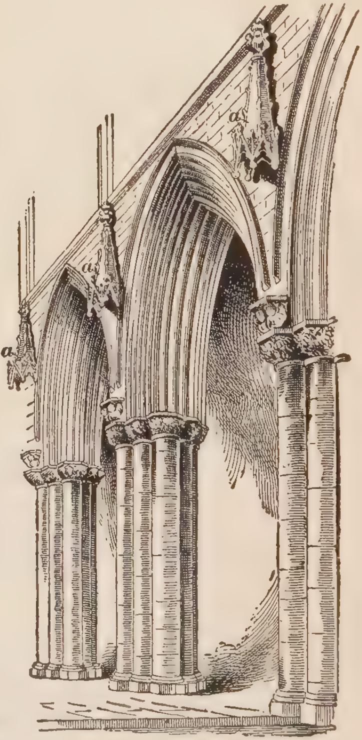

FIG. 60.

**122.** The late Norman work still retained the massive piers as a support, as shown in Fig. 57, though the molding of the arches gave them an appearance of lightness hitherto unknown; but advancement was rapid, and it was less than twenty years before the piers began to assume a shape, seen in Fig. 58, that could only end as it did in the multiclustered column of the Perpendicular style.

The arches of the early English period were deeply cut and molded, and were acutely pointed, as seen in the north transept of Westminster Abbey, Fig. 59. During the Decorated period they became still more acutely pointed, and in many instances have projecting canopies on the spandrels between, as shown at *a*, in Fig. 60.

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### GOTHIC MOLDINGS.

**123.** The earliest of these Gothic moldings (the Norman), Fig. 61, as shown in the nave of Fountain's Abbey, near Ripon, England, was simply a chamfered corner *a* on two square blocks with a *boltel*, or roll *b*, between. With the introduction of the pointed arch came the pointed boltel *a*, Fig. 62, and it opened the way to an immense number of new forms, the most important of which was the roll and fillet *b*, Fig. 62, as it is the prototype of nearly all subsequent formations. The characteristics of the moldings of this early style are the deep undercut hollows *e*, Fig. 63, between prominent members. These members include a great variety of pointed and filleted boltels, clustered, isolated, and repeated at certain intervals; a great depth or extent of molded surfaces, as shown by the entire molded surface of Fig. 63; and

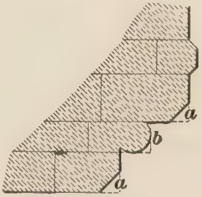

FIG. 61.

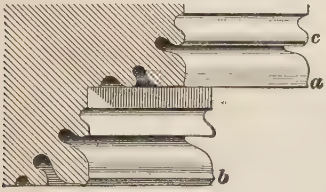

FIG. 62.

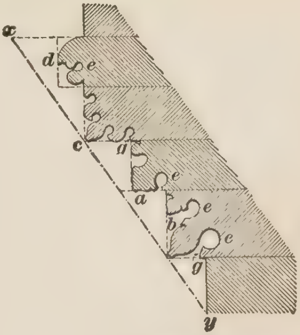

FIG. 63.

the general arrangement in *rectangular faces*, as shown by the dotted outlines of Figs. 61 and 63. The hollows *e*, Fig. 63, give the effect of a series of detailed arches or ribs, rising in succession; they are seldom true circles, but, like the projections, they assume a great number of capricious forms.

**124.** Early English moldings may be said to be nearly always composed of a combination of the following members: (1) the plain boltel *c*, Fig. 62; (2) the pointed boltel *a*; (3) the roll and fillet *b*; (4) the scroll molding *d*, Fig. 63; and (5) the angular forms consisting of chamfered ridges and intervening projections of an irregular character, as shown at *g*, Fig. 63. The other forms consist of a capricious modification of the roll and fillet.

The roll and triple fillet *a*, Fig. 63, appears late in the English Gothic style, and sometimes only one side is possessed of a fillet, as at *b*, Fig. 63. Three pointed rolls placed together, as at *c*, somewhat in the shape of a fleur de lis, form a combination of very frequent occurrence, with many minor varieties of shape. The scroll *d*, also called edge molding, was used only in the advanced early English and decorated work.

**125.** The details of decorated moldings are, for the most part, identical with those of the preceding style, with the addition of some new members and several important modifications in grouping. Much greater geometrical precision prevailed in drawing both the hollows and the projecting members during the Decorated period; and the segments of circles, both concave and convex, were much used, with an avoidance of strong contrasts of light and shade, thus imparting a much more pleasing, though less striking, effect. The perfection of molding, as of all architectural detail, is considered by many to have been attained at this period; yet during the Decorated period, rich moldings are of comparatively rare occurrence. Fig. 64 shows a

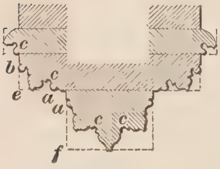

FIG. 64.

group of moldings from the choir of Howden Church, England, and is characteristic of the Decorated period. We get the addition of a few new members, such as the ogee *a*, and double ogee, and we see the plain boltel *b* used very sparingly. The hollows *c* are usually of larger size than those of the early English, and in the Decorated style are used to divide groups of members, while in the previous style they divided individual members.

**126.** The moldings peculiar to the Perpendicular period are weak in effect, and show a tendency on the part of the builder to save as much trouble as possible. Large and coarse members with little or no fine detail, broad but shallow hollows, as at *a*, Fig. 65, with hard wiry edges, take the place of the soft rounded forms we have just studied. Their general arrangement is on the surface of a large chamfer, instead of on the rectangular recessed surfaces we have observed in the two preceding styles. Compare, for example, the dotted outlines of Figs. 63 and 64, which determine the contour of the stone before the moldings were cut, and we see that in carving their moldings the early English architects followed very closely the rectangular offsets of the stone, and carried their moldings well into the projecting corners, as at *a* and *c*, Fig. 62. The builders of the Decorated period followed the general contour of the stone projections, but avoided the use of the corners of the projecting stones and chamfered them off before starting to cut their moldings, as at *e* and *f*, Fig. 64, while in the Perpendicular period the entire molded surface was chamfered off, and the moldings were cut along the chamfered surface, as in Fig. 65.

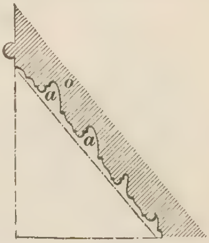

FIG. 65.

## PIERS.

**127.** The general plan of piers and columns supporting the principal arches in Gothic work varies from a plain square or round shaft, in the Norman work, to a complicated group of small shafts surrounding a central core, during the Perpendicular period. Piers of the earliest period were square, sometimes relieved by half columns, as at *a*, in Fig. 66, and in the early part of the twelfth century they began to assume the form of a Greek cross, as in Fig. 67, with engaged shafts in the angles, as at *a*, as well as on the principal faces *b*. As the style advanced, the smaller columns became detached from the shaft, and in Westminster Abbey we have a round column with four detached columnettes, as shown at *a*, Fig. 68; in a portion of the same structure erected during the Decorated period, we have also a central pier surrounded by eight small columns *a*, Fig. 69. A peculiarity of this latter example is that the eastern side *A* was completed during the Decorated period, and the western side *B* was erected during the period of the Perpendicular style, when the small columns became again attached to the central pier, indicative of the altered fashion of the day, when the detached piers, once so favorite a feature, were entirely discarded. The rectangular piers built during the Perpendicular period were in detail very similar to Fig. 67, but the solid center was oblong and not square.

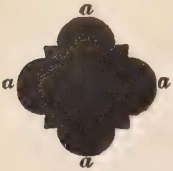

FIG. 66.

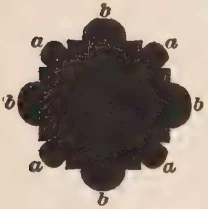

FIG. 67.

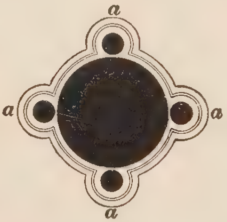

FIG. 68.

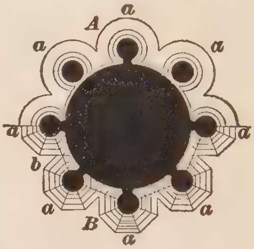

FIG. 69.

## CAPITALS.

**128.** The moldings of capitals and bases are more clearly marked in the various periods of Gothic architecture than are the variations of forms in piers and columns. In the Norman period, when the shaft was round, the highest and lowest members only were square, the parts immediately next to them being rounded off to suit the shape of the shaft, as shown in Fig. 70. This style of cap is also seen in the transept of Winchester Cathedral, as shown at *e*, Fig. 56. When the sub-arch was introduced, the corners of the capitals were usually cut off. This produced the octagonal form which afterwards gradually merged into the circular, bell-shaped capital, as shown in Fig. 71. When foliage was introduced in early English moldings, it was placed upon the bell of the capital, and but few, if any, moldings beyond the abacus and necking are used with it. The leaves have usually stiff stems, but almost always stand out very boldly, so as to produce a very striking and beautiful effect; they are generally well carved, and often so much undercut that the stalks and more prominent parts are entirely detached, as shown in Fig. 72. In the Decorated period, the molded capitals are generally enriched with the

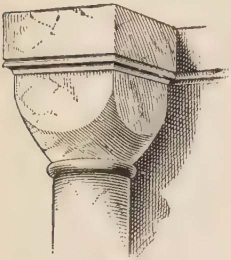

FIG. 70.

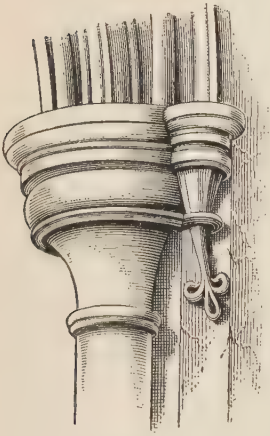

FIG. 71.

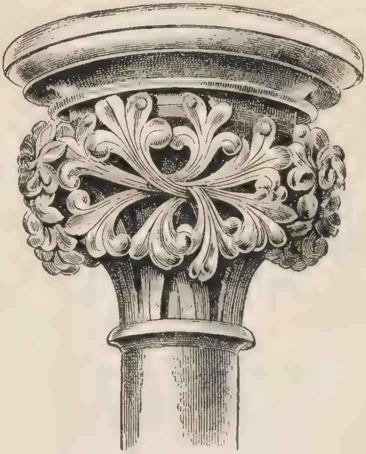

FIG. 72.

ball-flower ornament, as observed in *History of Architecture.* The foliated capitals are very richly carved, but are not undercut as much as in the early English style, and the leaves, as shown in Fig. 73, are accurate representations of particular plants and trees, as the oak, maple, ivy, white thorn, etc.

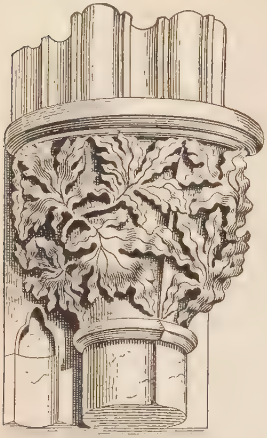

FIG. 73.

Perpendicular capitals were usually plain, though in very large and ornamented buildings they were sometimes enriched with shallow foliage, especially in the early years of the style, when the shafts were circular. The leaves when carved were generally of a very pronounced geometrical shape, such as square or triangular, as shown in Fig. 74, and were not as close an imitation of the natural form and growth as in the Decorated period.

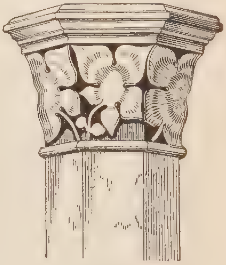

FIG. 74.

### BASES.

**129.** The bases used in the eleventh and twelfth centuries are often a sort of debased imitation of the Attic form used with the classic orders. In the Norman work, the plinth is no more than a square block or step of solid stone, but in the early English work, it is frequently octagonal, and the base moldings—a series of annular rolls, slopes, or hollows—take the form of the column. In Decorated and Perpendicular columns, the plinth is apparently omitted and the base is divided into heights, stages, or tables by gradually spreading courses, each separated from the

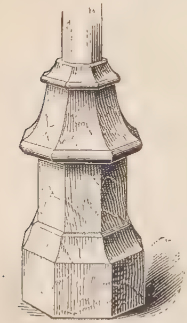

FIG. 75.

next by a plain or by a molded band. The lower part of the base is sometimes octagonal or polygonal, as in Fig. 75. In clustered pillars, with small shafts of different sizes, the bases are often on different levels, and consist of different moldings with only one or two members carried around the pillar, and those are generally on the upper part of the lower plinth.

### SPIRES.

**130.** The nature of the pointed Gothic vault was such as to necessitate very high pointed gables to cover its extremities, and we find this in keeping with all Gothic feeling. As has been observed before, the great contrast between Gothic and Classic work lies principally in the vertical lines of one and the horizontal lines of the other. The spire and tower make their first appearance in Gothic structures, and can be attributed very largely to the desire for long perpendicular lines. There are no set rules for the proportioning of spires, but the general rules illustrated in Fig. 47 nearly always give satisfactory results. If the elevation of a church is placed within the lines of an equilateral triangle so that the gables of the transept touch the sides of the triangle, then the spire may be extended until it reaches the apex of the circumscribed figure. This rule, however, is quite variable; as, when the spire is at the intersection of the nave and the transept, it should be higher, and when it stands at one corner of the structure, it should be lower.

Much in this respect depends upon the general character of the building itself and of the surrounding buildings, and upon the judgment of the architect. The proportions of height to thickness at the base, and the method of springing, are also matters depending almost entirely upon the skill of the architect. If the tower is to be the principal feature of the building, then it should be large, broad, and bold, like the dome of St. Paul's Cathedral, Fig. 113, *History of Architecture;* but if it is simply to be an adjunct to emphasize a certain tame corner in the design, or to call the eye away from a lot of monotonous detail, then it should not be excessively prominent, as is the Victoria Tower of the Houses of Parliament, in London, Fig. 130, *History of Architecture;* nor should it be dwarfed and insignificant, as is the central tower on the same building.

**131.** The construction of the tower and spire, however, requires very close study and attention. A bell tower erected to contain a single bell or a set of chimes should have a thoroughly solid foundation. It is preferable that such a tower should not contain a clock, as the vibration from the bells affects the mechanism.

The floors in a bell tower should always be built on offsets on the inside of the walls; as, if the timbers are let into the walls, they will rack and crack the joints clear through the masonry. Heavy bells should never be hung upon a cross-beam resting on the walls, but should be enclosed in a trussed cage, in order that the vibration may be largely taken up by the timberwork before it is transmitted to the walls. Where chimes are hung, they should be placed on one level in preference to two tiers, as the sound blends much better when they are close together.

Spires and towers should always be designed with a slight curve of entasis, for the same reason that the classic columns are so drawn. Towers should always have a taper or diminution in their lines, and if there are windows or other openings, the larger ones should be above the smaller ones —an arrangement which gives a feeling of lightness to the upper part of the structure and is pleasing to the eye.

# ARCHITECTURAL DESIGN.

(CONTINUED.)

## NATURE AND FUNCTION OF ORNAMENT.

### INTRODUCTION.

**1.** The term **ornament,** in its limited sense, includes such elements of decoration as are adapted or developed from natural forms and foliage. These differ from geometrical elements, inasmuch as they are organic, possess branches, leaves, blossoms, etc., while the latter are inorganic, and, for their expression, depend entirely upon their geometrical form and relative arrangement. When simply drawn on paper, and not in any way executed as an architectural feature, an element of decoration is considered, in the abstract, simply as an ornament, and only when such an ornament is applied to beautify an object does it become, in an architectural sense, an element of decoration.

**2.** The term **decoration** is applied to the process and result of applying the various elements to beautify objects or surfaces. The elements of decoration consist of geometrical lines, natural foliage, artificial objects, animals, and the human figure. These may be considered as ingredients, which are mixed and applied in various proportions, according to certain acknowledged rules, termed **principles.**

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**3.** The *principles* of decoration, as separated from the elements which are used to make up the design, depend upon certain rules of architectural proportion. This is illustrated in the subdivision of a wall surface into three horizontal bands, the dado, the wall, and the frieze; in the relation of a pedestal, column, and entablature of an architectural order. This general division may exist only in the placing of horizontal lines, and each separate part may be again subdivided or ornamented to constitute a theme of decoration. Subdivisions by means of lines are geometrical elements. The decoration of the subdivisions may be accomplished by means of natural foliage, such as leaves or running vines; by artificial objects, such as the hieroglyphics of the Egyptians; or by animals, and the human figure, as in the Gothic and Renaissance designs. But in each case the subdivisions must be proportioned to the general divisions, according to certain established rules, explained hereafter.

Whatever the theme of decoration may be, whether it be the invention of an original form, or only the arbitrary adaptation of some familiar idea, two conditions will always be found to exist: (1) The decoration produced by an arrangement and joining of dots and lines, or by the combination and division of geometrical figures in accordance with the laws of rhythm, regularity, and symmetry; and (2) the decorative *effect* arising from the attempt to represent the objects of the external world. Nearest at hand for imitation is organic nature, with the plants, animals, and human form; but inorganic nature also offers models, as the forms of crystallization, snowflakes—all phenomena of nature, such as clouds, waves, etc.; and rich sources are opened up by artificial objects, which are fashioned by man himself.

It is obvious that all kinds of elements may be combined. Geometrical may be united with natural forms, and details taken from nature may be combined with creatures of the human imagination, to form eccentricities which are not existent in nature, but which man has always delighted in adopting to represent some supernatural power. Among these may be cited the sphinx, the centaur, and the mermaid of ancient art, while human and animal bodies with plant-like and foliated terminations are prevalent in many details of Renaissance design.

**4.** Decoration, as applied to architecture, consists, first, of the ornamentation of the structural features of the building, of the variation in color or proportion of different surfaces which are adjacent, and in the application of familiar symbols or objects, to convey a definite historical or religious idea to the mind. All architectural decoration is influenced by its historical period, by its geographical surroundings, and by the conditions of the religion and the intellect of the people by whom it is applied.

Historically, the decoration of no two periods is exactly alike. Geographically, the scheme of ornament of no two countries (save in the things of their mutual local surroundings) is alike; and inasmuch as nearly all decoration makes use of symbolic forms, the variations of religion will effect a corresponding variation of the symbols used. These, combined with the other influences, give us an unlimited field for combinations of ornamental design, which, though practised for centuries, has not yet exhausted originality.

## ARRANGEMENT OF FORM AND COLOR.

**5.** All decorative arts, whether carving, wall painting, or ceramics, arise from, and should be attendant upon, architecture, as architecture is the material expression of the wants, facilities, and sentiments of the age in which it is created. And also, as in architecture, all products of the decorative arts should possess fitness, proportion, and harmony, in order that the result may express what we term *repose.* Beauty results from that repose which the mind feels, when the eye, the intellect, and the affections are satisfied and free from any sense of want. Construction may be decorated, as has already been explained, but decoration should never be purposely constructed. It, therefore, may be stated that, as that which is beautiful is true, conversely, that which is true must be beautiful; and upon this axiom depends all the beauty of ornament in architecture.

**6.** In the decoration of a surface, the general form is first cared for, and subdivided and ornamented by general lines. The interstices may then be filled with ornament, or may themselves be again subdivided, if desirable, and enriched for closer observation. But all ornamentation, no matter how minutely carried out, should be based upon a geometrical system of construction, as a true proportion will be found to exist between all the members so based. In every perfect work of architecture, and throughout the decorative arts, every assemblage of forms should be arranged in certain definite proportions, each and every member of which should be a multiple of some governing unit.

In surface decoration, a rule to be observed in all work is that all lines should flow from a parent stem, so that every ornament, no matter how distant, can be traced back through its branch to its root; that all junctions of curved lines with other curved lines, or of curved lines with straight lines, should be made so that, at the junction, the lines will be tangent to each other. Flowers and other natural objects should not be used as ornaments in their natural forms, but should be conventionalized or reduced to geometrical principles, which convey the idea of what they represent without purporting to be an accurate likeness of the original.

**7.** **Color** may be used to assist in the development of a form, or idea, or to distinguish objects, or parts of objects, one from another; or color may be used to assist light and shade, helping the undulations of form by the proper distribution of several different tints; but color should never be used unless the exigencies of the case positively require it, and all design should depend for its intrinsic beauty upon its form and proportion, which may be enhanced by combinations of color, but should never depend entirely upon the color itself.

## EGYPTIAN ORNAMENT.

**8.** The peculiarity of Egyptian architecture over all other styles is that the more ancient the monument, the nearer perfection is the art. Monuments erected two thousand years before the Christian era are built of stones taken from the ruins of still more ancient and more perfect buildings. Hence, we are not only compelled to study Egyptian art during the period of its decline, but are equally compelled to accept the art of that period as an original style, as we have no record of the existence of any earlier nation from whom they could have borrowed ideas.

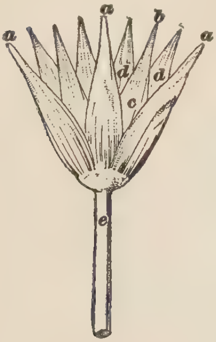


FIG. 1.

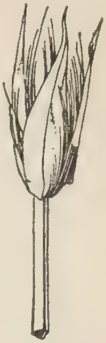


FIG. 2.

In Egyptian art we have no traces of infancy or of foreign influence, and we must, therefore, believe that the Egyptian artists drew their inspirations direct from nature. In Egyptian ornament the types are few but natural, and the representation is but slightly removed from the type. The later we descend in art, the more we find the original types receded from, until it is difficult in many cases to discover the original idea from which the ornament, by successive mental efforts, has been developed.

**9.** The lotus, Fig. 1, and the papyrus, Fig. 2, growing on the banks of the Nile, symbolic of physical and mental food; the feathers of rare birds, Fig. 3, carried or held before the king, emblematic of sovereignty; and the palm branch, with the twisted cord made from its stems—are the few types which form the foundation of the immense variety of ornament with which the Egyptians decorated the temples of their gods, the palaces of their kings, the covering of their persons, and their articles of luxury, as well as those articles of more modest daily use, from the wooden spoon which fed them in infancy, to the mournful boat which carried their embalmed bodies across the Nile to their final resting places in the Valley of the Dead.

Following these types as they did, in a manner so nearly allied to the natural form, they could hardly fail to observe the same laws which the works of nature ever display, and we therefore find that Egyptian ornament, no matter how conventionalized, is always true. The Egyptian artist never violated a natural principle, nor, on the other hand, did he destroy the consistency of the representative by a too servile imitation of the type.

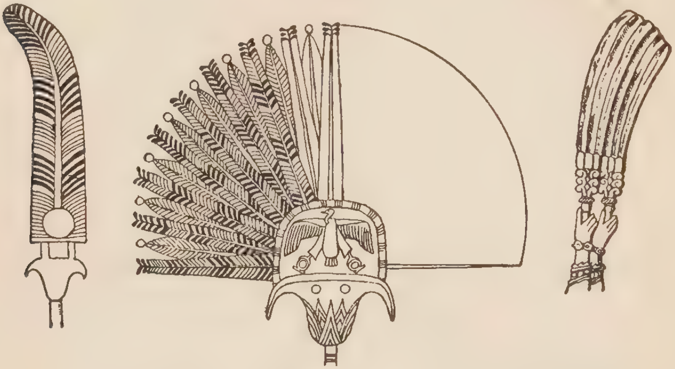


FIG. 3.

A lotus carved in stone, forming the graceful termination of a column, or painted on the walls as an offering to the gods, was never such a one as might be plucked, but was an architectural representation of it.

**10.** Egyptian ornament is of three kinds: that which is constructive, or forms a part of the monument itself; that which is representative, but is at the same time conventionally rendered; and that which is simply decorated. In each case the ornament is always symbolic, and the few types on which it was founded were but slightly changed during the entire period of Egyptian civilization.

Of the constructive ornament are the decorations of the columns and crowning members of the walls. The column base was frequently molded to represent the root, the shaft was reeded in imitation of the stalk, and the capital was carved in the form of a full-blown lotus flower. All this was symbolic, as the lotus flower meant much to the Eygptian.

**11.** The lotus blossom was very similar to the ordinary pond lily, except that it grew on a stiff stalk and its petals were tipped with deep purple. It bloomed in abundance on the banks of the Nile, and was associated with all the blessings the Egyptian derived from that fertile river and plain. Hence, the columns of his temples were nearly always fashioned on the symbol of the lotus plant, representative of the abundance of Providence.

The cornices of the temples were usually decorated with ornaments derived from a combination of feathers, which were an emblem of sovereignty, while in the center of the cornice and over each entrance was the emblem of divinity and immortality, the winged globe (Fig. 4).

**12.** The winged globe is one of the most conspicuous details of Egyptian ornament. It varies slightly in detail, according to the purpose and place where it is used, but consists essentially of a globe or disk, on each side of which spreads a hawk's wing, as shown in Fig. 4. The coiled asp as emblematic of royalty is sometimes added to the disk, but not always. There is no other architectural detail so characteristic of its style and nation as is the winged globe in ancient Egyptian art.

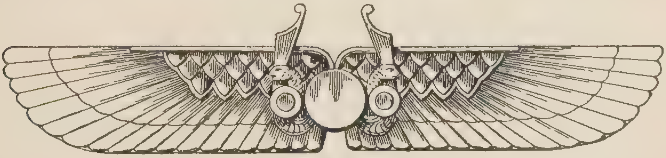


FIG. 4.

Carved over their doors, painted on their walls, and woven into their fabrics, the Egyptians portrayed this emblem of their sincerity wherever opportunity arose.

**13.** The second kind of Egyptian ornament results from the conventional representation of actual things on the walls of the temples and tombs. These representations, whether indicative of an offering to the gods, or illustrative of a utensil of daily use, are not portrayed as a reality, but are conventionalized to an architectural ideal. Each object is a hieroglyphical record of a fact, and at the same time an architectural decoration. This representative ornament was sometimes carved in the surface of the walls, and sometimes simply painted, while in other cases it was carved and painted also. Fig. 5 shows a somewhat conventionalized bunch of papyrus and lotus blossoms, as these types were frequently arranged for wall decoration, as seen in the tombs and temples. The symmetry each side of the center line is characteristic of this style of Egyptian ornament, as is also the rich coloring, which, however, these illustrations do not show. Observe the straight, stiff stem, the trumpet-shaped blossom, the sharp-pointed petals of the calyx—all characteristics of the growing plant, which are emphasized in this section of ornament in order to secure absolute conventionalism. Fig. 6 shows another, but simpler, rendering of the papyrus plant, which is identical in character with Fig. 5, but devoid of a single line unnecessary to its conventional portrayal. The straight stem, the trumpet blossom, and the sharp petals are all here, but are rendered in a monotint as a purely hieroglyphic inscription, with the omission of every detail not necessary to the conveyance of an idea. A single glance at Fig. 6 is sufficient to impart the information that it portrays a papyrus plant—more than that it does not express, nor is intended to do so.

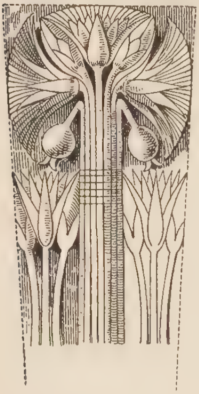


FIG. 5.

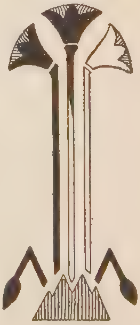


FIG. 6.

**14.** The third kind of Egyptian ornament, that which is purely decorative, is found mostly in paintings on tombs, dresses, utensils, and *sarcophagi*, or stone coffins.

The architecture of the Egyptians is thoroughly *polychromic*, or many colored—they painted everything. They used only *flat tints*, however, or those without shading, and yet found no difficulty in conveying to the mind the identity of the object they desired to represent, without the aid of either shade or shadow. A fair idea of the conventionality of their forms may be obtained by a comparison of Figs. 1 and 7. Fig. 1 is a sketch of the lotus blossom as it appears in nature. The outside leaves *a* are a deep green in color, while the petals *b* are a rich purple at the tips, but shade off to pure white at *d*, except the outside row, which shades to orange at *c*, while the stem *e* is a light green. In Fig. 7 is the conventional representative of the lotus in Egyptian painting. In this case the outside leaves of the calyx *a* are a dark green, and the next row of leaves *b* are green also, but of a lighter shade, while the petals *c* are painted red, and the background *d* is a deep yellow. At a distance from the eye, the red and yellow blend and form an orange tint, suggestive of the color of the heart of the flower. The colors used by the Egyptians were principally red, blue, and yellow, with black and white to define and give distinctiveness to the various colors. Green was frequently,

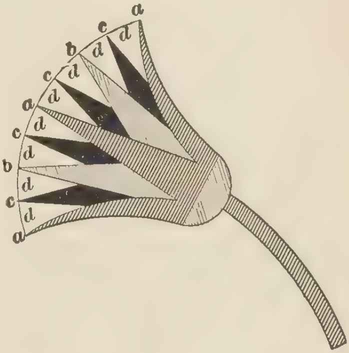


Fig. 7.

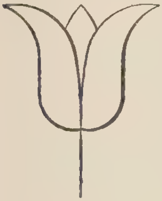


Fig. 8.

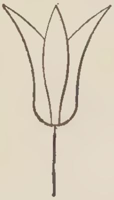


Fig. 9.

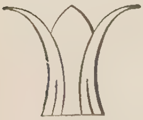


Fig. 10.

but not always, used as a local color, such as for the leaves of plants, etc., and as many representations of the lotus blossom are painted with blue leaves as with green.

When the lotus was drawn only in outline or painted in *monochrome*, or one color, we find its form still more conventionalized into such shapes as Figs. 8, 9, and 10, and these latter forms undoubtedly had very considerable influence on later art forms, as will be observed when we reach that period.

## GREEK ORNAMENT.

**15.** Egyptian ornament, we have seen, was derived from natural inspiration. It was founded on a few simple types, which remained unchanged during the whole course of Egyptian civilization, except in the greater or lesser perfection of the execution. The Assyrian style was borrowed from the art of Egypt, during the decline, which decline they carried still further, but the Greek art, on the contrary, though it was borrowed partly from the Egyptian and partly from the Assyrian, was the development of an old idea in a new direction; unrestrained by religious laws, as both the Egyptian and the Assyrian appear to have been, Greek art rose rapidly to a state of perfection from which it was able to give forth the elements of future greatness to other styles. It carried the perfection of pure form to a point which has never since been excelled, and from the abundant remains we have of Greek ornament, we must believe that refined taste was duly appreciated, and that the land was overflowing with artists whose hands and minds were so trained as to enable them to execute these beautiful ornaments with unerring truth.

Greek ornament lacks, however, one of the greatest charms which should always accompany ornament, namely, *symbolism*. It is purely decorative, never representative, and in some cases not strictly constructive. Like the Egyptian style, the types are few, but the drawing is so conventional that it is often difficult to recognize the original type.

In the well known painted honeysuckle ornament, shown in Fig. 11, it is difficult to recognize any attempt at imitation, but rather an appreciation of the principle on which the flower grows. And in the carved ornament shown in Fig. 12, also from the honeysuckle, how faint is the resemblance.

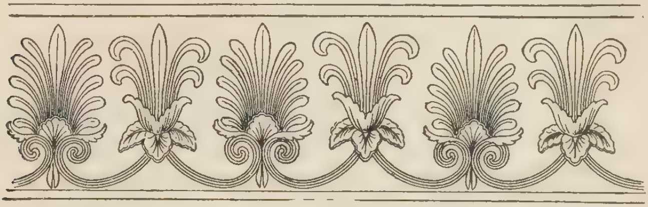


FIG. 11.

But it is evident that the Greeks were close observers of nature, and though they did not copy or attempt to imitate, they worked on the principles which governed the growth of the plants they conventionalized. There are three great unalterable laws which we find everywhere in nature; these are: *radiation from the parent stem*, *proportionate distribution of the areas of the branches and leaves*, *and the tangential curvature of the lines*. These laws were invariably obeyed by the Greek artists, and it is the unerring perfection with which they were realized by the Grecian that renders the reproduction of the Greek system of ornament so rarely crowned with success at the present day.

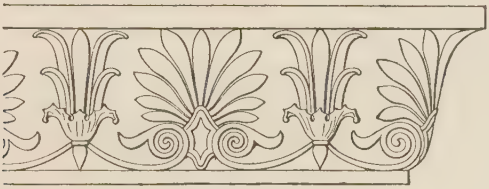


FIG. 12.

A characteristic feature of Greek ornament continued by the Romans, but abandoned during the Byzantine period, is that of the various parts of a scroll growing out of one another in a continuous line, as shown in the ornament from the choragic monument of Lysicrates, Fig. 13. In the

Byzantine, Moresque, and early Gothic styles, the flowers flow off on either side of a continuous stem, showing how a slight change in any generally received principle is sufficient to generate an entirely new order of forms and ideas. Roman ornament appears to be constantly struggling against this apparently fixed law. Fig. 25 is an example which may be taken as typical of the scheme of all Roman ornament, which scarcely ever advanced beyond the arrangement of a volute, springing from a stem, which fitted into another stem and encircled a flower. The change which took place during the Byzantine period in discarding this law, is as important in its results to the development of ornament as was the substitution of the arch by the Romans for the straight architrave of the Greeks, or the introduction of the pointed arch in the architecture of the middle ages, as we shall learn as we progress.

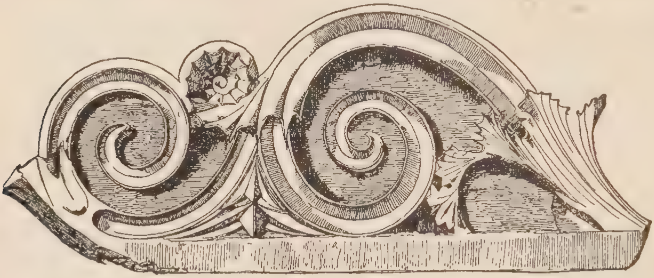


FIG. 13.

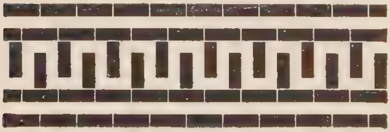


FIG. 14.

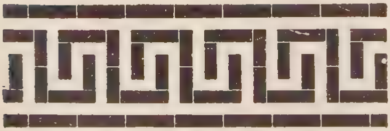


FIG. 15.

**16.** The simplest and most ancient form of ornament we find in Greece is the *fret*. By what race it was first introduced is not known. It existed in its simpler form in the earliest epochs of Egyptian art, and is probably derived from an arrangement of differently colored bricks, as Figs. 14 and 15 would suggest. In early Egyptian hieroglyphics we find two characters, Fig. 16, which are component parts of frets, and which, when combined, as in Figs. 17, 18, and 19, comprise the earliest forms we are familiar with in fret ornament. However, whether the fret was introduced by the early Egyptians or not, it is practically certain that the Greeks adopted it from Egypt; and, like the Doric column, which they borrowed from the same source, they improved on the original and brought it to the state of perfection found in all Greek art. The Greek fret differs from all its predecessors in the fact that the line of the fret is always continuous, and is not broken, as are the Egyptian and Arabic examples, while the lines of the fret and the spaces between them form, in most cases, a similar pattern.

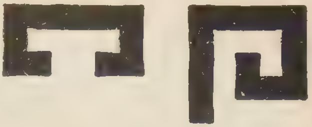


FIG. 16.

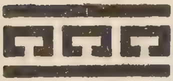


FIG. 17.

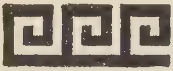


FIG. 18.

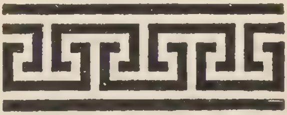


FIG. 19.

**17.** On the plate entitled, Vases and Borders, *Ornamental Drawing*, we find the perfected Greek fret in Fig. 9, while Fig. 10 shows a later and more intricate application of the same idea, known as a *meander*, on account of its intricate interlacing straps or ribbonwork. From the meander to the *guilloche*, Fig. 11, is but a step in design, and the *guilloche*, in its various forms, is the ornament with which the *torus molding* of the Grecian bases is most frequently enriched.

Fig. 20 shows a complicated form of the guilloche carved on the torus of the base of a pilaster in the Temple of Nemesis, at Rhamnus, and is here suggestive of a tightly braided strap.

On the same base is seen a bead molding *c*, cut into the globular and disk forms mentioned under the description of classic moldings. On the plate entitled, Conventionalized Leaves, *Ornamental Drawing*, we have, in Fig. 6, a waterleaf ornament used in various forms to decorate the cyma reversa, as is also seen at *a* in Fig. 20, with the bead *b* again adjacent to it. This ornament cannot well be made to miter neatly on the angle, hence we find the corners finished with a form of either the honeysuckle or the lotus-flower ornament, as seen at *a*.

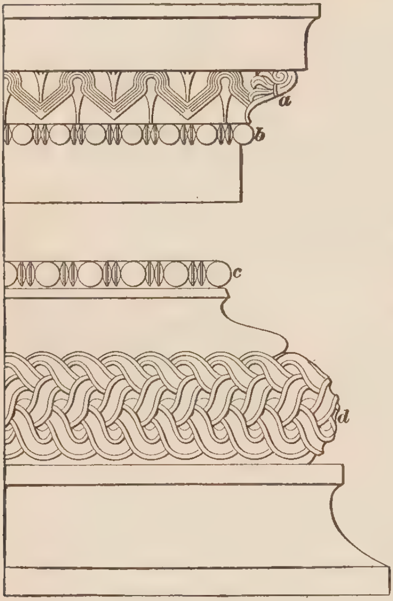


FIG. 20.

The honeysuckle vine formed one of the favorite objects of ornament and decorative design with the Greeks, and they invented a great variety of ornamental figures which were based on conventionalized forms of the honeysuckle blossom. What the lotus blossom was to the Egyptians, this honeysuckle flower seems to have been to the Greeks, though in many instances they used the lotus blossom and also its leaves, especially in painted work.

**18.** In the ornamental forms which they borrowed from the vegetable kingdom, the Greeks were as simple and homely in their tastes as they were in the general character of their architecture. Instead of embellishing their structures with carved and painted representations of the more elaborate and cultivated plants, we find beautiful ornaments which had for their prototypes the running vine of the pumpkin and squash, and leaves of parsley, celery, etc. On the plate entitled, Conventionalized Leaves, *Ornamental Drawing*, we have, in Fig. 3, conventionalized forms of the leaves of these latter plants, while Figs. 1 and 2 are geometrical forms of the lotus flower.

Fig. 1 of plate entitled, Applied Ornament, *Ornamental Drawing*, is a late Grecian palmette, or fan ornament, of conventionalized honeysuckle, and shows the form in which this flower was frequently represented. As said before, the Greeks made use largely of the lotus flower in their decorations, and indirectly it was used in nearly every point of their ornament. Many, if not most, of the Greek art forms are traceable to Egypt, and a large majority of Egyptian art forms are traceable to the lotus flower or lotus bud. The conventionalized forms of lotus illustrated in Figs. 8, 9, and 10 were often used as a border or frieze decoration, and the form shown in Fig. 10, when used as a painted border, Fig. 21, is strongly suggestive of the possible prototype of the egg-and-dart ornament with which the ovolo was generally enriched. The cyma recta or the ovolo, when they formed the uppermost or crown molding of the cornice of the building, were usually decorated with the lotus and honeysuckle ornament carved in low relief, as shown in Fig. 12, or were painted in the quieter colors, as illustrated in Fig. 22.

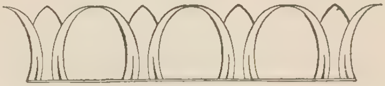


FIG. 21.

**19.** *Polychromy* is the term applied to the ornamentation of sculptured and architectural works by means of colors. In ancient buildings these colors were made to cover both flat surfaces and architectural details, while in statues or individual portions of the human figure, and drapery, and in other products of plastic art, separate features of a sculptured ornament were colored in a manner characteristic of the subject.

Egyptian polychromy, on columns, bases, capitals, entablatures, wall spaces, and, in fact, on almost everything of an architectural character, expressed itself in a series of highly colored designs in low relief, consisting mostly of figures and hieroglyphics, and often of purely decorative ornament.

In Greek architecture a complete system of color had been developed at an early period, particularly as applied to Doric temples, upon numerous remains of which, traces of this coloring are still distinguishable.

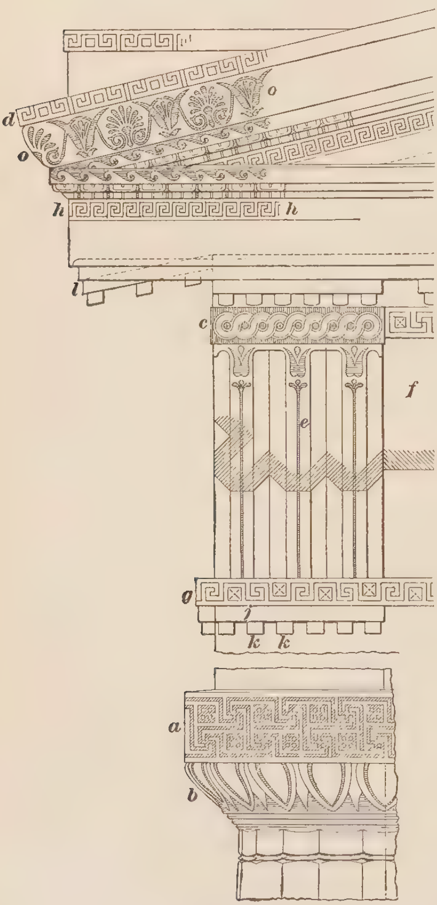


Fig. 22.

The principal use of color in architecture is to bring out decoration. Surfaces may be relieved by a rich play of color without actual relief, and ideas may with facility be expressed by colors, when the object they embellish calls for the widest possible range of imagination and fancy. Still, color has its own province, and to a certain extent its own series of forms, and must, therefore, be treated in its own manner. A harmonious interplay of colors, with correct proportion in the distribution of each, is characteristic of a fine work of art. In truly artistic periods, color has never been used to produce artificial shadows or to bring out artificial depths and reliefs; nor has it in any way been employed as a makeshift for them.

Figs. 22 and 23 show examples of Greek painted ornament in which the fret and the lotus and honeysuckle ornament are both prominent. Red, yellow, blue, and green were the principal colors used by the Greeks in these decorations, but they were so toned down and softened that the glare and harshness of such brilliant colors were blended into one delightful monotint, as one viewed their structures from a distance. Fig. 22 shows a portion of the capital, entablature, and pediment of the Grecian-Doric order, with the characteristic polychromic ornamentation. The fretwork on the abacus at *a* was usually executed in a dark red or black, while the groundwork was pale yellow or orange. The egg-and-dart ornament on the echinus of the capital *b* was generally painted in red on a dark-blue ground. The triglyphs *c* were nearly always blue, and any ornament *e* on them was executed in red. The metopes *f* were generally red, and the sculptured figures with which the metopes were ornamented were painted in tints which represented the color and texture of their garments.

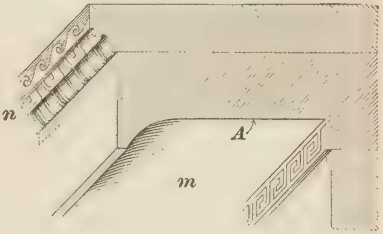


Fig. 23.

The fret drawn on the tænia, or fillet *g*, and those on the corona and epitithedas, as at *h* and *d*, were usually executed in gold, though occasionally in red. The regulæ *j* were blue with red drops, or guttæ *k*, as were also the mutules *l*, but the soffit of the corona *m*, shown in Fig. 23, was red. The small moldings *n* forming the finish to the corona were generally painted in light colors, such as red and blue, with spaces of white alternating between. The honeysuckle or lotus ornament, usually found on the cyma recta, or ovolo *o*, Fig. 22, when either was the top molding of the pediment, was carefully outlined in gold, and was always drawn very lightly and delicately when used to embellish this top member of the entablature.

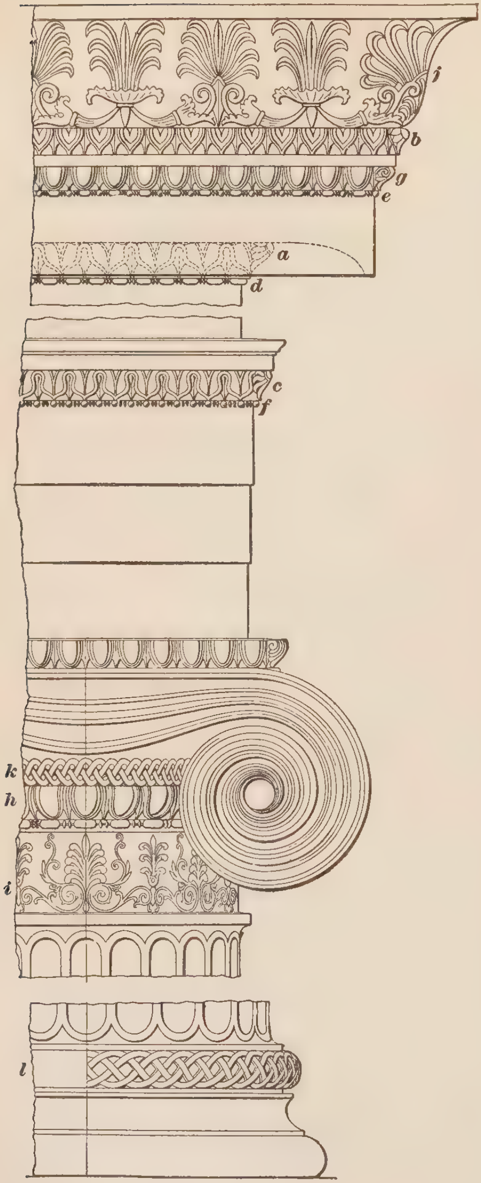


FIG. 24.

**20.** In Fig. 24 are shown examples of *raised*, or relieved ornament, as seen in the details of the Temple of Athena Polias, in the Erechtheum at Athens. The enrichment on the cyma recta *j* is the lotus-flower ornament, and is carved in very low relief; that is, it is so cut as to be raised but slightly above the surface of the molding, and is not sunk into it as was customary with the Egyptians. As we examine later monuments of Grecian architecture, we find the relief of the carvings increasing, until, when we reach the Greco-Roman period, the stems and stalks are in many instances so undercut as to be almost clear of the molding.

The waterleaf carving on the cyma reversa occurs three times in this entablature, and is of varied form, according to its location. Up under the corona at *a*, where the shadow is deep and dark, the waterleaf is cut broad and bold, but immediately below the cyma at *b*, and above the upper facia at *c*, the lines of the leaf are drawn longer and narrower, so that the moldings appear in more delicacy of outline where the full strength of the light strikes it. The same thing may be said of the bead moldings under the corona at *d* and under each of the two lower cymæ reversæ at *e* and *f*. The one in the shadow of the corona, as at *d*, is cut into long beads, while the one above the corona, as at *e*, is divided into much more minute divisions; and the one on the top of the upper facia, as at *f*, being in the strongest light of all, is turned into forms where the *bead* is simply a tiny sphere between two pairs of disks of the same diameter. The egg-and-dart ornament of the ovolo occurs here above the corona of the entablature at *g* and under the guilloche and volutes of the capital at *h*, the only difference in these two examples being that the one above the corona is carved upon a straight ovolo extending along the top of the corona, while the other is carved in the circular echinus surrounding the top of the column. The honeysuckle ornament cut on the neck of the column *i* is in low relief, the same as that upon the crown molding *j*. The guilloche *k* immediately under the lines of the volute is carved as a thin strap, loosely braided, around the top of the column, and the same ornament is cut on *l*, the upper torus of the base.

## ROMAN ORNAMENT.

**21.** The most characteristic expression of Roman art is to be found in their palaces, baths, theaters, aqueducts, and other works of public utility, and not in their temple architecture, which, being only a monumental evidence of a religion borrowed from the Greeks, in which the Romans had little faith, exhibits a corresponding want of earnestness. In the Greek temple it is everywhere apparent that the struggle was to arrive at a perfection worthy of the gods. In the Roman temple the aim was self-glorification.

From the ground line to the crown molding every part is overloaded with ornament, tending rather to dazzle the eye by the quantity than to excite the admiration by the quality of the work. The Greek temples, when painted, were ornamented as much as those of the Romans, but with far different results, as the ornament was so arranged that it threw a colored bloom over the whole edifice and in no way disturbed the exquisitely designed surfaces which received it.

The Romans failed to appreciate the general proportions of the structure and the contours of the molded surfaces, which in their structures were entirely lost by the elaborate carving on them of rich surface ornament—ornament that did not appear to grow naturally from the surface of the molding, but was applied to it. This may be most clearly illustrated by the acanthus leaves under the modillions and around the bell of the capital of the Corinthian column. The leaves are not bound together by the necking at the top of the shaft, but rest on top of it. In contrast to this is the Egyptian capital, where the stems of the flowers around the bell are continued through the necking, thus expressing at the same time both beauty and truth. In the use of the acanthus leaf, the Romans exhibited but little art; they inherited it from the Greeks, beautifully conventionalized, but they exaggerated the surface decoration, though they approached much nearer the natural outline. The Greeks

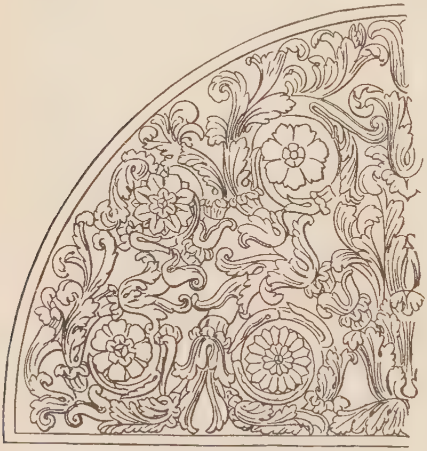


FIG. 25.

confined themselves to the principle of the foliation, and bestowed the greatest care on the delicate undulations of its surfaces. Fig. 25, as said before, is typical of all Roman ornament, a scroll growing out of a scroll encircling a flower. In Greek ornament the scrolls grow out of each other in a similar way, but they are much more delicate and refined at the point of junction. The acanthus leaf is also seen in side elevation in Greek work, but very rarely in Roman.

**22.** The purely Roman method of using the acanthus is seen in the Corinthian capitals (see plate entitled, Corinthian Details, *Advanced Architectural Drawing*), where the leaves are flattened out and lay one over the other. The amount of design that can be obtained by working out this principle of leaf within leaf, and leaf over leaf, is very limited, and it was not until the principle of one leaf growing out of another in a continuous line was abandoned for the adoption of a continuous stem throwing out ornaments on either side, that pure conventional ornament received any advancement. The earliest symptoms of the change are found in the Church of Hagia Sophia, at Constantinople, and the first examples of the complete change mark the dawn of the Byzantine style.

**23.** The decoration and enrichment of Roman moldings, like all the rest of their ornament, was excessive and inartistic. The Greeks decorated one or two of the moldings of their bases with a guilloche and a bead, while the Roman idea of enrichment was to cover the entire base, and even a portion of the shaft, with applied ornament. The torus was usually decorated with laurel leaves or oak leaves, Fig. 26, or in some cases with scrolls of acanthus, Fig. 27. The ovolo, instead of being simply carved with an egg-and-dart

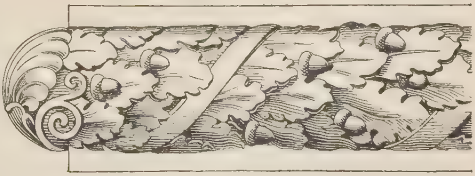


FIG. 26.

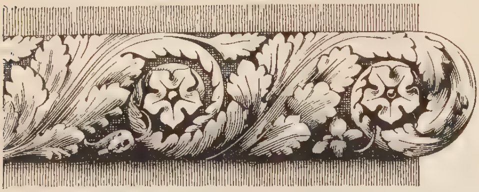


FIG. 27.

ornament, is lavishly decorated with a leaf-and-tongue ornament, or with the egg-and-leaf ornament as seen in the Temple of Jupiter Tonans, at Rome. The cyma reversa, which the Greeks enriched with the simple waterleaf ornament, was complicated by the Romans into the form shown in Fig. 28. The Roman cyma recta was decorated with a complicated variety of ornaments of which the acanthus leaf predominated. The frieze, especially of the Corinthian order, was frequently carved or painted to represent scenes in the lives of the gods, or from other mythological tales, as in the Forum of Nerva, at Rome.

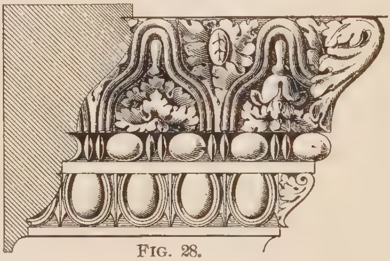


FIG. 28.

## BYZANTINE ORNAMENT.

**24.** When Constantine the Great transferred the seat of his empire from Rome to Byzantium, in the year 330 A. D., he found himself under the necessity of employing oriental workmen and artists to carry out his ideas and erect his buildings. There can be little doubt that each of the surrounding nations aided in giving its impress to the newly forming style, according to the civilization each possessed and its capacity for art advancement, until the motley mass finally became fused into one systematic whole, during the long and artistically successful reign of Justinian I, from 518 to 565 A. D. In the result can be seen the influence exercised by the great Roman temples and theaters, built in Asia Minor during the rule of the Cæsars. In these we see the tendency to elliptical outlines, acute-pointed leaves, and thin continuous foliage, without the springing base and flower which characterize Byzantine ornament.

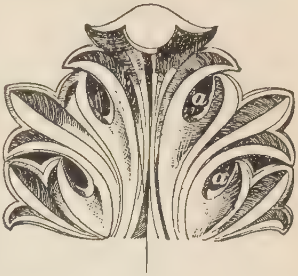


FIG. 29.

These buildings of Asia Minor having been erected under the influences of Syrian and Persian art, as well as that of other countries, we see that their effect on the birth of the Byzantine style must have been to give it a certain amount of oriental tinge according to the state of religion, art, and civilization, in the countries where it was received.

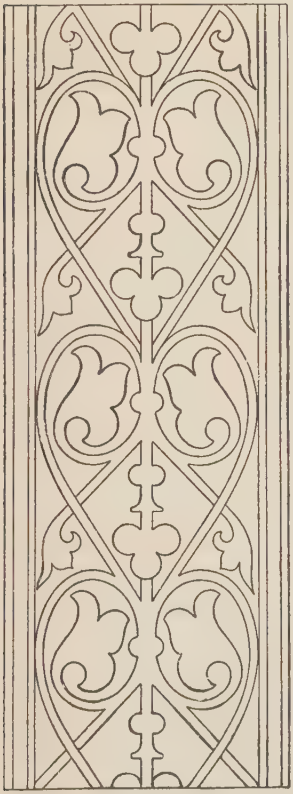


FIG. 30.

Pure Byzantine ornament is distinguished by broad-toothed and acute-pointed leaves, which in

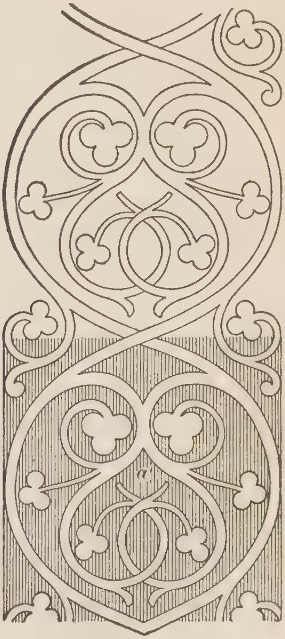


FIG. 31.

sculpture have the edges beveled and are deeply channeled throughout, and have deeply-cut incisions at the loops of the leaves as shown at *a*, Fig. 29, which is a carved acanthus leaf from the Church of Hagia Sophia at Constantinople.

The running foliage is generally thin and continuous, as shown in Figs. 30 and 31, and the background *a*, whether in mosaic or painted work, is almost universally gold. Thin, interlaced patterns were preferred to geometrical designs, and the introduction of animal figures was very limited, especially in sculpture. In painted work the human figure is sometimes introduced, but is confined almost entirely to religious subjects, and is rendered in a stiff, conventional style, with little variety or feeling. In fact, sculpture in Byzantine art is of secondary importance.

## ROMANESQUE ORNAMENT.

**25.** Romanesque ornament differs from Byzantine in relying mainly on sculpture for effect. It is rich in light and shade, deep cuttings, massive projections, and a great intermixture of figure subjects with foliage and conventional ornament. The place filled by mosaic work in Byzantine art is occupied by painted work in the Romanesque, and in the polychromic ornament animals are as freely introduced as in the sculpture. The backgrounds are no longer exclusively of gold, but are mostly blue, red, or green. In other respects, making some allowance for local influences and religious differences, Romanesque ornament retains much of the Byzantine character, especially in stained glass-work, and this character is continued to the middle, and in some cases to the close, of the thirteenth century. There is no record of the number of Byzantine workmen and artists who were employed throughout Europe, but there can be but little doubt that the character of the Byzantine school of ornament is very strongly impressed on all the earlier works of central, and even western, Europe, which are generally termed Romanesque.

There is, however, one style of ornament distinctly characteristic of the Romanesque period, especially in Italy, and that is the geometrical mosaic work, Fig. 32. It consists of an arrangement of small lozenge-shaped pieces of glass in a complicated series of lines, the direction of which is defined by other pieces of different shapes and colors. The examples found in central and northern Italy are much simpler than those in the southern part of the country, and in Sicily, where Saracenic artists introduced their innate love of intricate design, this ornament assumes a most complicated style.

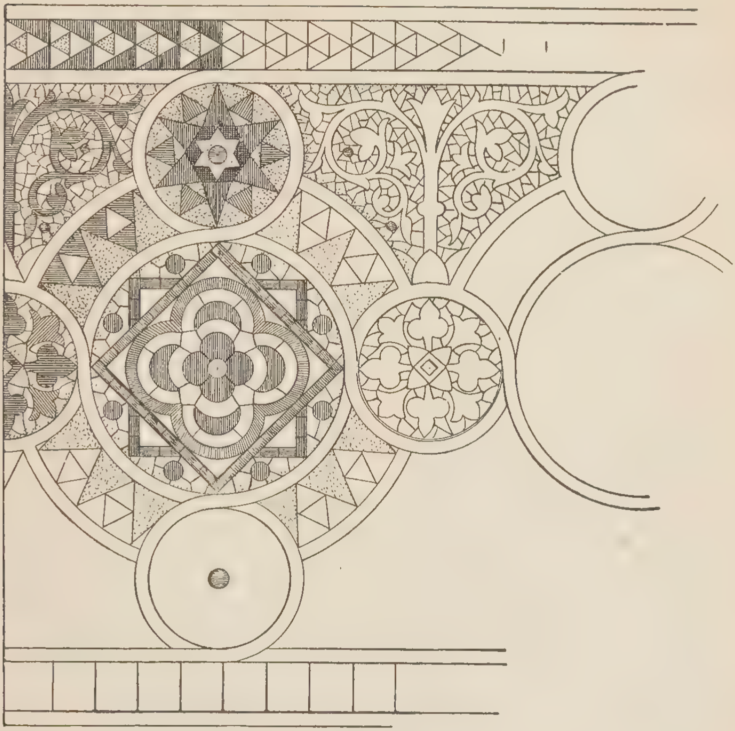


FIG. 32.

## GOTHIC ORNAMENT.

**26.** We are now entering a period when the art forms of Rome and Greece had been so long unthought of that they were entirely forgotten, and in most localities unknown. The Romanesque builders, in their earliest efforts, had the memory or inheritance of Roman forms and Roman construction to influence their works; but after they succeeded in emancipating themselves from this influence, they never returned to it, and succeeding generations grew up in utter ignorance of the fact that such a thing as Roman art ever existed.

The transition from the round arch of the Romanesque to the pointed arch of Gothic architecture, is readily traced in buildings where the two styles are intermingled, as shown in Fig. 55, *Architectural Design*, § 21, but the passage from the style of ornament of the Romanesque to the variations of that style, as exhibited in the Gothic period, is by no means so clear. By this time all traces of the acanthus leaf have disappeared, and a purely conventional style of ornament is prevalent in all buildings of the Gothic style. The nearest approach to the acanthus type is found in some of the illuminated manuscripts of the twelfth century, Figs. 33 and 34, which probably derived many of their features from the ancient Greek manuscript.

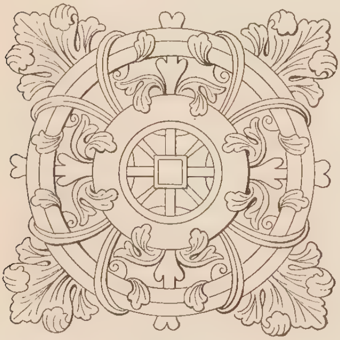


FIG. 33.

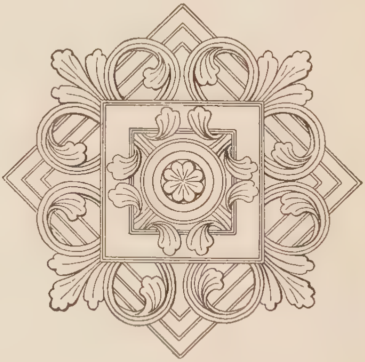


FIG. 34.

Fig. 33 illustrates an ornamental centerpiece geometrically constructed on a circle, while Fig. 34 shows a similar ornament constructed on a square. The foliage in each bears a strong resemblance to the acanthus, but trained more on Gothic lines than the classic leaf. Gothic ornament is usually formed by a continuous stem throwing off leaves on the outer side and terminating in a flower.

Early English ornament is very perfect, both in principle and in execution. There is as much elegance and refinement in modulations of form, as there is in the ornament of the Greeks. It grows naturally from the structural features of the building, and is always in perfect harmony with them. It fulfils every one of the requirements of a perfect style of architecture, but it remains perfect only so long as it remains conventional. As the style advanced from the early English through the Decorative to the Perpendicular period, it became less idealized and more in direct imitation of natural forms, and ceased to be an ornamentation of structural features, but became ornament applied. In the capitals of the early English columns the foliage rises directly from a shaft, which, above the necking, appears to split into a series of stems, each stem terminating in a leaf or flower. This method of decoration is analogous to the mode of ornamenting the Egyptian capital, and is purely original and symbolic. In the Decorative style, however, there is a much nearer approach to nature. It appears to have been no longer possible to treat a natural leaf as a portion of the shaft, and the columns are therefore terminated in a bell-shaped capital around which the leaves are apparently twined, somewhat after the manner of the Roman-Corinthian capital, as shown in Fig. 35, and more

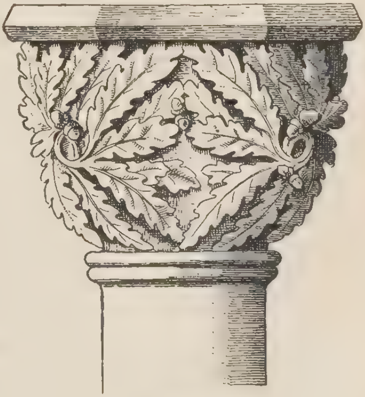


FIG. 35.

and more natural as these become, the less artistic becomes the arrangement. In the spandrels of the arches, too, so long as the conventional style was retained, one vigorous main stem was distributed over the spandrel, from which sprung the leaves and the flowers as in Fig. 36. But when realism was attempted, the stem ceased to be a guiding form of ornament, and lost all grace and architectural character in the endeavor to represent in stone the softness and suppleness of nature. The main stem as a leading feature finally disappeared, and the spandrels are often filled with three immense leaves springing from a twisted stem in the center, Fig. 37, whose position and relation to the rest of the construction affords no explanation of why it should be there.

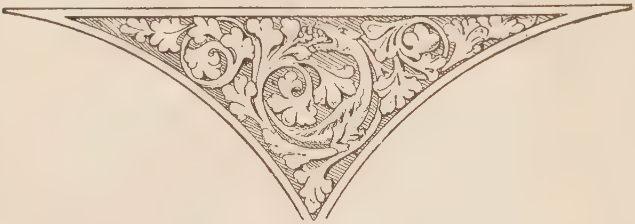


FIG. 36.

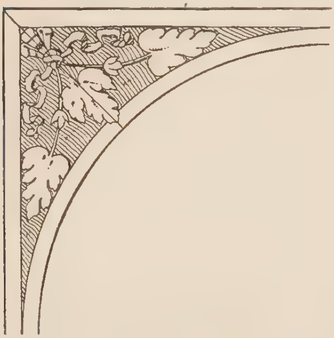


FIG. 37.

The same idea occurs in the bosses which cover the intersections of the ribs of the vaulting. In early English work the stems of the flowers are continuations of the lines of the moldings of the ribs, Fig. 38, while in later periods the intersections were entirely concealed by the overlaying boss,

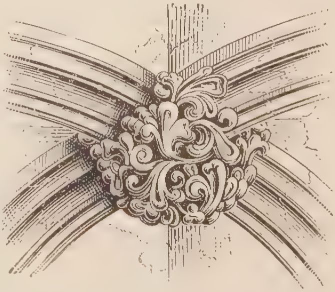


FIG. 38.

as in Fig. 39, which became here simply applied ornament, as were the leaves on the capitals.

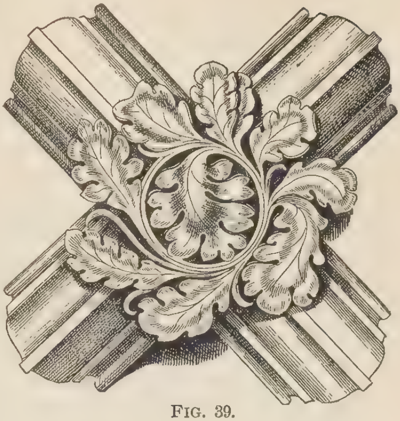


FIG. 39.

**27.** In the manuscripts and the bookbinding of the twelfth and thirteenth centuries, we find many ingenious geometrical designs with which foliage is combined in order to effect a proper scheme of ornamentation, but illuminated manuscript does not afford a satisfactory guide to the period of any style, as much of it is copied from more ancient manuscripts, and some of it was an imitation of other illuminations of an entirely different origin. Many of the corner pieces, borderings, and designs of pieces executed on the covers, bindings, and title pages were extremely ingenious in conception, and the better of them adhere to the original Gothic system of a wavy parent stem, from which all ornament branched on one side or the other.

**28.** Modern Gothic work is based not so much on the principle of the old Gothic scheme of decoration as upon direct imitation of Gothic forms. Gothic architecture is, unfortunately, associated, in the mind of the modern practitioner, more with vaulted ceilings and the pointed arch than with the principles of Gothic construction, which are directly responsible for the existence of this form of arch. In the revival of Gothic art, there never appears to have been an honest attempt to reproduce the principles of the Gothic school. Much carving and detail, and even whole sections of ancient structures, have been reproduced and pressed into service to accommodate the demands of modern circumstances, but few, if any, cases exist where the accurate conventionalism of the early English architecture has been made the fundamental principles of a modern architectural design. The development of the crockets and finials was based upon a close observation of nature, the crockets representing the curled leaves as they appear when they fall from the trees and dry on the ground, Fig. 40, the finials representing bunches of foliage, their sharp, accurate details expressing what they were without particularizing any specific form. In modern work, the crockets and cornice carvings, as shown in Fig. 41, are but an imitation of the old crockets, the finials representing, as before, a bunch of leaves or flowers; but effort is made, on the part of the carver, to distinguish what kind of leaves they are, and to give a naturalistic appearance to their shape and position, as if to make them appear more lifelike or to portray them

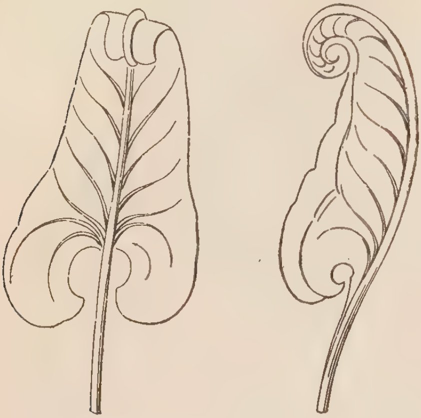


Fig. 40.

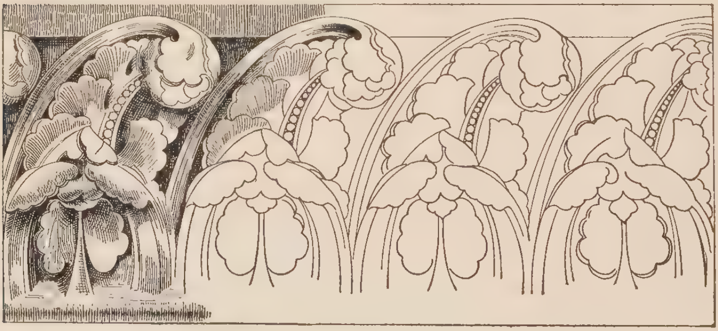


Fig. 41.

closely to the type from which they were derived. In addition to this, foliage decoration (on both crockets and finials) is often called upon to express an idea further than its connection with an apparently lost art. The leaves, in some cases, stand in an upright position, as though extending towards the sun, spreading out as widely as possible, touching, and in some cases overlapping, one another, as shown in Fig. 42. Such an arrangement is usually considered to be symbolic of *day*, as opposed to some neighboring and corresponding finial, with the leaves drooping and hanging from the ends of the stems, emblematic of *night*, Fig. 43.

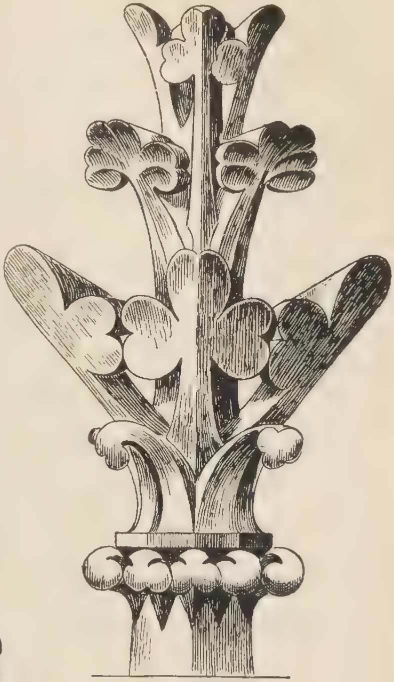


FIG. 42.

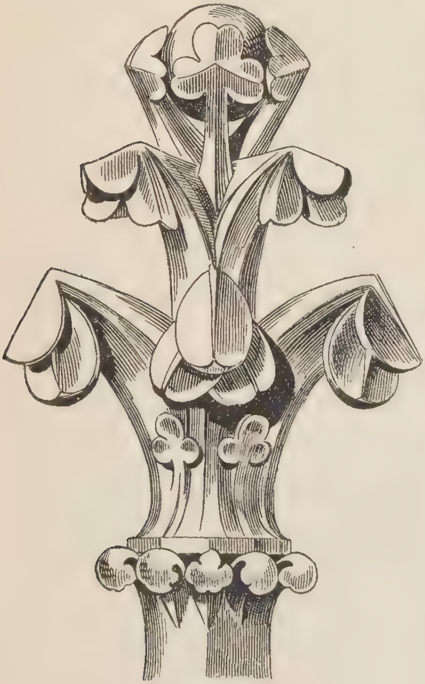


FIG. 43.

**29.** In surface carving, the leaves and foliage are very much undercut; a branch is twisted and split up into minute subdivisions, each of which carries a leaf; or some sort of an insect will appear to have alighted on one of the leaves,

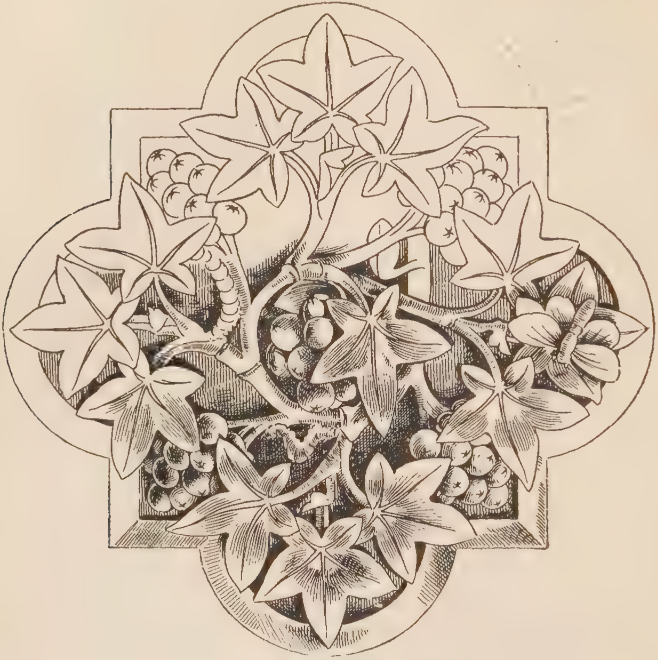


FIG. 44.

Fig. 44; all of which is an attempt to execute in stone an expression of lightness and thinness which the material is

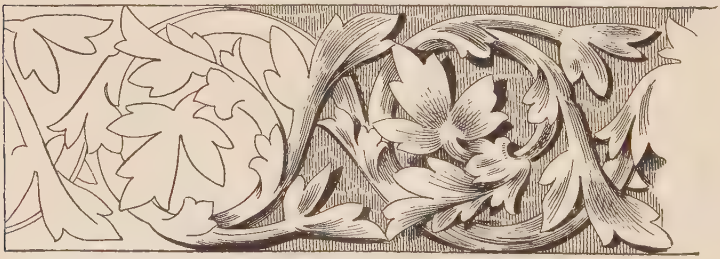


FIG. 45.

incompetent to convey. The twisting of the stem, and the arrangement of the leaves to form borders is somewhat on the original Gothic principle of the wavy stem and tangential branches, but the resulting scrolls are more suggestive of Roman than of early Gothic work, Fig. 45.

**30.** In English Gothic of old or modern date, much foliated work is carved in wood; the doors to cabinets, the fronts of dressers, the panels of wainscoting, etc. are sometimes richly elaborated with carved design. These designs frequently include conventional forms of national emblems, the foliage taking the form of thistles, roses, shamrocks, etc., as in Figs. 46 and 47, according to the locality represented. While all this satisfies the mind from a symbolic standpoint, it is hardly adequate to permit the designs to be classed as high art, as the execution is after the manner of the Decorative period, where the details are deeply undercut

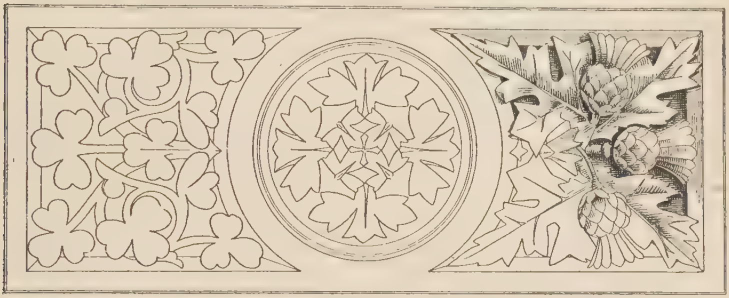


FIG. 46.

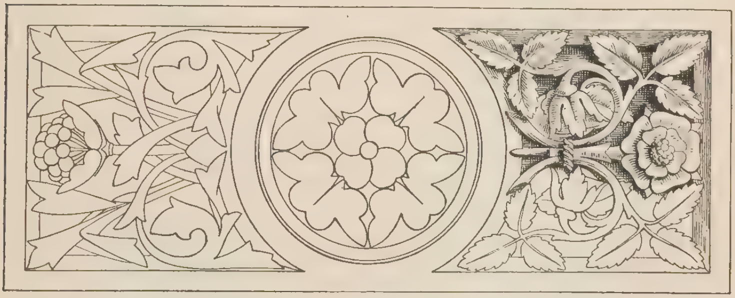


FIG. 47.

and adhere closely as possible to the proportions and shapes of the original plants, rather than to their system of growth.

Fig. 48 shows a section of frieze ornament in modern French Gothic. The ornament is much more conventional than the revived English style and is designed more on the lines of the principles of growth than on the accuracy of form of the type.

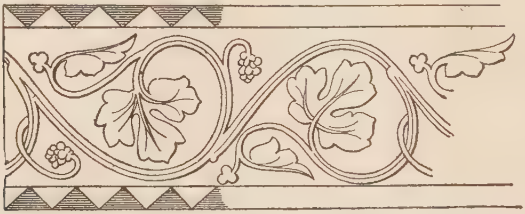


FIG. 48.

**31.** Throughout all ages, we have seen that art and ornament were more or less affected by the style which preceded them.

The acanthus leaf, originally conventionalized by the Greeks, was adopted by them direct from nature and bequeathed to the Romans, who materially altered its mode of treatment before handing it down to the next architectural generation, the Byzantine.

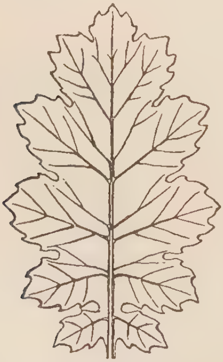


FIG. 49.

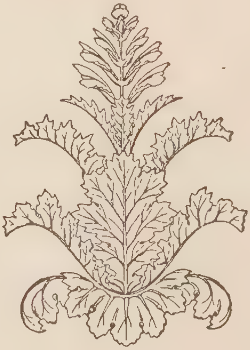


FIG. 50.

Fig. 49 shows the natural acanthus leaf as it would appear pressed out flat, while Fig. 50 shows the calyx of the acanthus, with the leaves and flower. The Greeks conventionalized the pressed leaf into the form of Fig. 51 and carved it as shown in Fig. 52. When the Roman school of art took up the acanthus, they modified it to the form of Fig. 53, and so carved it on their Corinthian capital.

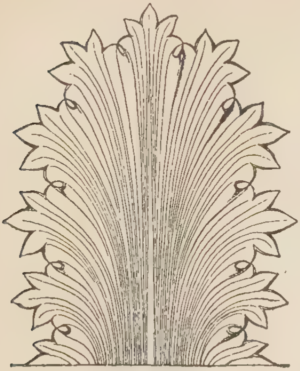


FIG. 51.

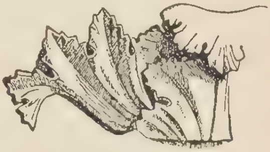


FIG. 52.

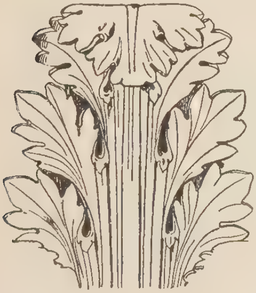


FIG. 53.

Such was the acanthus throughout the entire Roman period; but with the inspirations and encouragements of a new school of art, we find the leaf gradually assuming some of its old form and refinement, until, with the building of the Church of Hagia Sophia, we see it carved in the sharp and expressive form of Fig. 29. In the Romanesque church at St. Denis, France, we also find it in an advanced stage of improvement, as shown in Fig. 54, and we can follow its steady advancement towards an ideal form, until, at the birth of the Gothic school,

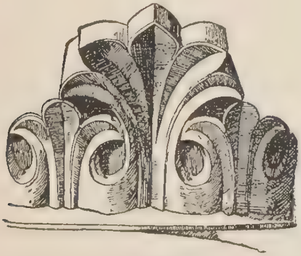


FIG. 54.

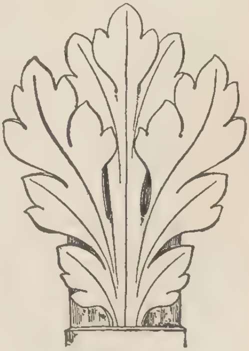


FIG. 55.

it was shut out entirely as a thing that was heathen and wicked.

Its ostracism was hardly universal, however, for in Italy and the south of France we find a Gothic leaf like that in Fig. 55, which could have had for its prototype none other than the classic acanthus.

## RENAISSANCE ORNAMENT.

### ITALIAN RENAISSANCE.

**32.** Modern buildings, when designed in the style of the Renaissance, are classified according to the period of the style, when we refer to their interior decoration or furniture; and nearly always according to the country of the style's local development, when we refer to the exterior or to the building as a whole. The exceptions to this rule are the Renaissance and revival designs in Great Britain, where the name of the period is usually applied to the design of both the exterior and interior. For instance, we speak of a building as being in the style of the French Renaissance when we are describing the effect of the whole structure; but we refer to the rooms of its interior as being in the style of Francis I, Henry IV, Louis XIV, etc., all of which are distinctly French Renaissance, but each one is a particular period of it, and differs materially from both its predecessor and successor.

In speaking of the architecture of Great Britain, we describe the buildings as Elizabethan, Queen Anne, or modern Gothic, whether we refer to its exterior detail or its interior arrangement. It will, therefore, be clear to the student, that a comprehensive understanding of the distinctive characteristics of the styles of the different periods is absolutely necessary to the creator of a perfect design.

**33.** The general character of the style of Italian Renaissance, as regards the exterior designs, and the causes leading up to the change, are described in *History of Architecture*, to which the student is referred.

The ornament in the Italian Renaissance style is of the same general character, whether used in the Florentine, Venetian, or Roman school, and in modern work the architect designs the interior of his edifice without much regard to the local school in which the style of the design was perfected. A slight exception to this might be mentioned in special cases where the architect, for local or individual reasons, desires to give the building a somber, severe appearance, and molds his design on the style of the Florentine school; or, where the lightness and delicacy of the Venetian school would, with its slightly Byzantine tendency, better suit some peculiar characteristic of the proposed design; or, where, as in the design of a palace or public building, the luxury and grandeur of the Roman school might be singularly appropriate.

The most important thing to be borne in mind is that in designing a building in any style, the end to be sought is not the faithful reproduction of any detail or group of details characteristic of the period of the style, but the expression in the design of the temperament and circumstances which caused the style to exist.

Fifteenth-century Renaissance was an attempted reproduction of the ancient Roman customs. During this period the people over all civilized Europe imitated the classic manners, the Roman style of dress, and the Imperial system of government.

The principal rooms of a palace or villa had side walls divided into a number of panels, as shown at *a*, Fig. 56, these panels being separated by a semidetached column or a pilaster and pedestal, as at *b*, which extended to the top of the panels and supported a full entablature *c* under the ceiling.

The top moldings *h* of the pedestal *g* were carried around the room over a marble wainscot, or dado, *k*, and the lower members, or moldings, *l*, were carried under the dado to form a base. When the column or pilaster was used without

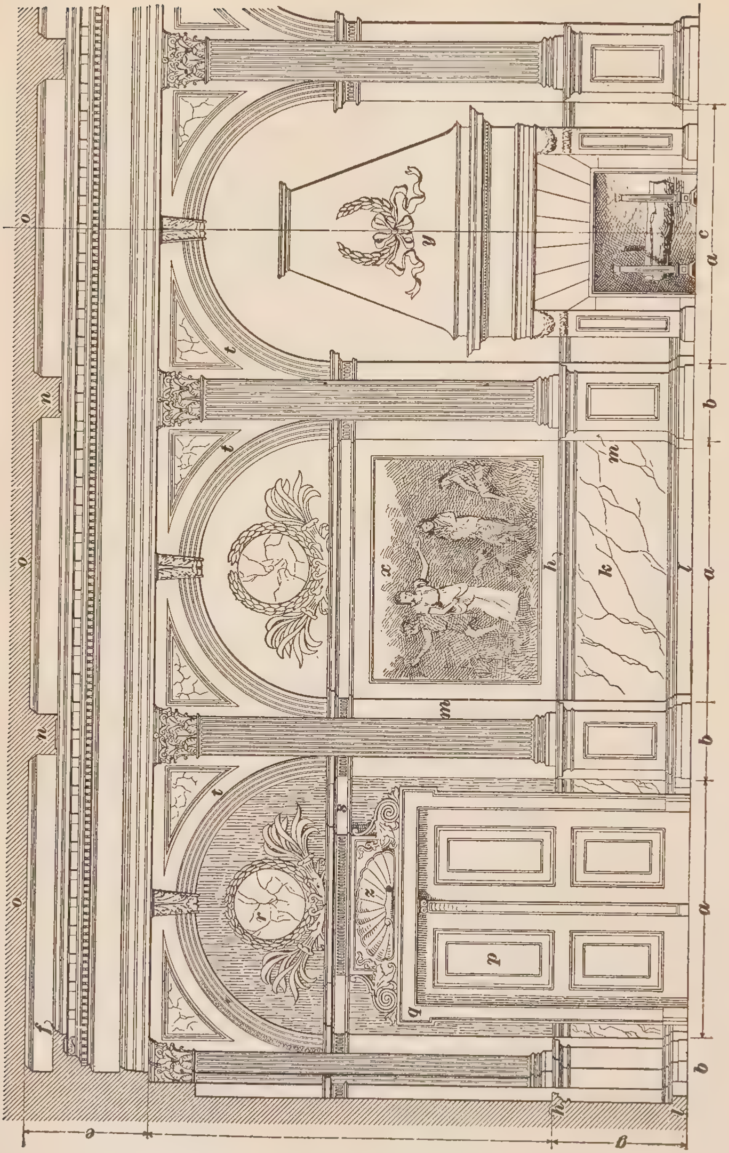


FIG. 56.

a pedestal, it stood upon a high plinth, and the moldings of the base around the room stopped against the projecting plinth, while the moldings on the base of the column or pilaster stopped against the impost pier *m*. Upon the top or crown molding *f* of the entablature rested, in a line with each pilaster, a ceiling beam *n* which divided the ceiling into a number of square panels *o*, each of which was decorated with paintings or frescoes. The center lines of doors, windows, and other features were located exactly in the center of these wall panels, as at *c c*, and each feature became a means of ornament therein. The doors were liberal in dimensions and surrounded by a trim *q* richly molded, as were also the panels at *p*. Above the door head was usually a heavy carved ornament *z* reaching to the springing line of the wall arches *t*, which were the usual finish to the panels bordered by the pilasters. At the spring of the arch itself the impost moldings *s* were carried across the wall panels, and the semicircle thus formed was ornamented with a marble *cartouche*, or carved wall ornament *r*. The spandrels *t* were paneled with rich marbles or sometimes with frescoes, and the capitals of the pilasters were frequently gilded to represent solid gold. Where the wall panels were open from top to bottom, they were usually decorated with paintings or hung with tapestry, as at *x*. These tapestries were woven of the most costly materials and hung loosely in frames built in the walls. They were usually designed in brilliant colors representing religious subjects, as contrasted with the painting of mythological deities seen on the ancient Roman walls.

The central panel of the room occasionally contained a large open fireplace and mantel *y*, with andirons typical of the Roman style, or a brazier identical with the classic design.

**34.** In the interiors of these palaces and villas, which are more closely allied to the purposes for which most modern structures are embellished, we find extravagant elaboration by the artist and the sculptor, highly enriched columns and pilasters, and a decided taste for gorgeously painted or decorated ceilings. The shafts of the columns, the faces of the pilasters, and the friezes of the entablatures are rich with sculptured and painted ornament, in many cases more extravagant than the decorations of the Palace of the Cæsars.

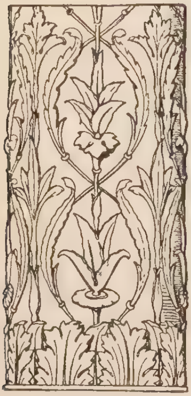


FIG. 57.

Fig. 57 is a portion of the shaft of a column in a tomb at Rome designed by the celebrated architect, Sansovino, and shows the style and extent of this columnar enrichment. The capitals of these pilasters and columns were usually a modification of the Corinthian or Composite order, but their alterations in many instances were so extensive that recognition was scarcely possible.

Fig. 58 is a pilaster capital from the Scuola di San Marco, at Venice, and Figs. 59 and 60 are carved wooden capitals from pilasters in the Palazzo Vecchio, at Florence. In many instances, especially in modern Renaissance work, these

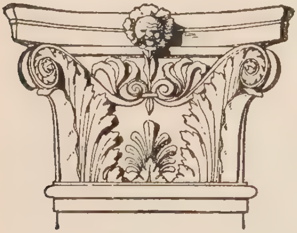


FIG. 58.

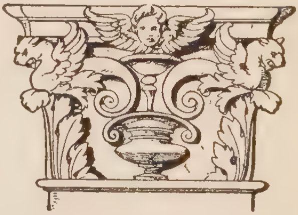


FIG. 59.

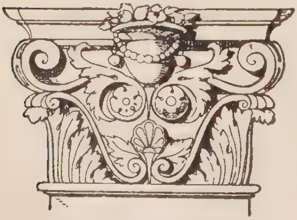


FIG. 60.

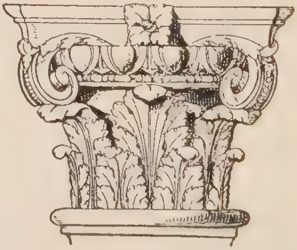


FIG. 61.

pilasters are executed in plaster, with their capitals gilded, and the arabesque or scroll ornaments in the panels are wrought in bas-relief or painted in rich, harmonious colors.

**35.** The capitals of columns are also very frequently gilded, while the shafts, made usually of rich and costly colored marbles, are seldom grooved or fluted, but finished with a high and brilliant polish. The Composite and Corinthian orders are the principal ones here used, as with the pilasters, and occasionally preference is given to a very much modernized form of the Roman Ionic, but the Doric and Tuscan are rarely seen in Renaissance work. Fig. 61 shows a Composite capital of the Italian Renaissance style, and Figs. 62, 63, and 64 show the variety and extent of mangling to which the Corinthian forms were subjected to make them suit the taste of the Renaissance designer. Fig. 62 is from the Palazzo Scrofa, and Fig. 63 is from another design of Sansovino's, at Rome.

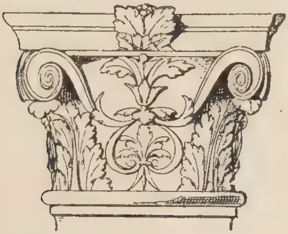


FIG. 62.

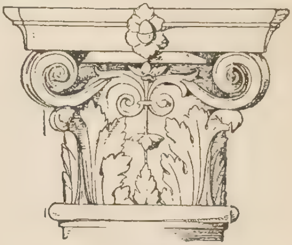


FIG. 63.

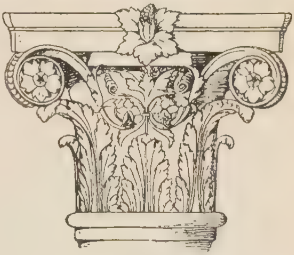


FIG. 64.

## FRENCH RENAISSANCE.

**36.** Renaissance ornament, as seen in France, is divided into four general periods, each distinguished by the name of the sovereign most prominent in the encouragement of art during each epoch.

The first period, that of Francis I, extends from about the year 1483 to 1560. The second period, known as that of Henry IV, extends from 1560 to 1642. The age of Louis XIV, as the third period is called, includes the years from the end of the last epoch to the French Revolution in 1792. The period of the Empire extends from the reign of Napoleon I down almost to the present day, although the style of ornament peculiar to this epoch was developed almost entirely before the end of the reign of Louis XVIII, in 1824.

There is a marked difference in the progress and development of Renaissance ornament in France, as compared with that in Italy. Surrounded by the classic forms and ruins of antiquity, the Italian artists could not cultivate a taste for Gothic forms, and after a short struggle with medieval art, they returned to the style of ancient Rome. Further, the Italians were direct descendants of the very authors of these classic forms, and naturally inherited a latent taste for them; while the peoples to the north and west were the posterity of half-savage tribes, who, though they conquered Rome, lacked the culture and refinement necessary to appreciate the art of their vanquished neighbors.

**37.** Francis I, king of France, being much impressed by the new art forms he saw in Italy, invited several Italian architects to Paris to execute some work for him. Italian Renaissance ornament was thus introduced into France in its pure form, and many of the monuments built by these imported artists are decidedly more Italian than French.

The workmen, however, were natives of French soil, and had learned their trades and derived their experience on Gothic structures under the direction of Gothic architects; hence the earliest Renaissance ornament in France is tainted with Gothic lines, and even the Italian masters could not get pure classic detail from under the chisel of the long experienced Gothic stone carver. When the Gothic architects themselves attempted to design buildings in the style of the Roman school, the results naturally exhibited the thirteenth-century training, and the ornament of the period of Francis I is thus an imitation of the Italian forms executed with Gothic materials.

Exteriorly we see the high-pitched roof and pointed gables of the former period intermingled with the arabesque pilasters and Corinthian capitals of the Italian school. Within the walls we find the long, narrow panels, the elliptical arch, and the twisting, flamboyant lines, so prominent in the declining days of the Gothic school; but the columns, pilasters, moldings, and carvings savor strongly of the classic model. As the style advanced, the classic influence became more marked, and the vertical lines, so characteristic of the Gothic school, began to divide honors with equally important horizontal lines of classic origin. Finely molded belt courses at the sills and heads of the windows marked the different stories, and were crossed by a system of vertical lines formed by superimposed pilasters, flanking the windows continuously from basement to roof.

Elaborate dormer-windows, with high and ornate gables and pinnacles, diversified the high-pitched roof, and the pilasters were treated like long panels and ornamented with arabesques of great beauty. The moldings were fine, delicate, and richly carved, and stone-mullioned windows were preferred to the more generous openings seen in the Italian buildings. High dormers and round-corner towers with turrets and pinnacles carried to excess were features of this period that continued late into the succeeding styles.

**38.** As the style of Francis I advanced to the middle of the sixteenth century, it lost much of its earlier charm. The orders were used with increasing frequency, and conformed more closely to antique precedents. Facades were flatter and simpler, cornices more pronounced, and the arches were heavier in style and more Roman in their general treatment, while the delicate arabesques, so characteristic of the early part of the period, gave way to a heavier style of carving and ornament. With the period of Henry IV, Renaissance ornament had taken a firm hold on the architecture of the country, and Gothic detail was considered obsolete. But the French architects had learned their art in the Italian schools, and Henry IV had married an Italian queen, so that one could hardly expect other than a close imitation of the Italian forms, with less and less individuality as the style advanced.

The characteristics of this period belong more to external architecture than to interior decoration, and consist of a close imitation of the classic orders, with the rustic stonework of the Florentine school, and the large, airy openings of the Roman Renaissance, as described in *History of Architecture.* In interior work, large arabesque pilasters, elaborately paneled wall decorations, heavy moldings, and large projecting cornices seem to be preferred, while the hangings and furniture are suggestive of the luxury and idleness of the days of the reign of the Cæsars.

**39.** The period known as the age of Louis XIV covers the reign of that king, as well as that of his two successors, Louis XV and Louis XVI. This was an age of remarkable literary and artistic activity, as well as of progression. A style of ornament developed in the reign of Louis XIV can be traced through the sovereignty of each of his successors, and the changes wrought upon it clearly observed.

The general character of Louis XIV style is even more classic on the exterior than that of the Henry IV period, but it is also free from the extravagances of the Italian school seen in contemporaneous buildings. This is probably due to one circumstance more than any other, and that is the fact, that Lorenzo Bernini, the celebrated Italian architect of St. Peter's colonnade, was invited to France to prepare plans for the Louvre Palace, and that, after doing so, his plans were not accepted by the king, who preferred the design submitted by Claude Perrault, a French physician. This preference of a native artist to the celebrated designer of St. Peter's colonnade materially lessened the influence of the Italian school in French art, though we find the resulting structure of Perrault conforming closely to the Roman orders as analyzed by Palladio; it is at the same time quite free from the vagaries exhibited in the later days of the Italian Renaissance.

**40.** Fig. 65 is a form of leaf ornament much used in the arabesques of Italian Renaissance design during the period when Francis I and his predecessors, Louis XII and Charles VIII, invaded Italy. Its character is free and untrammeled, apparently governed by no rule which bids it turn one way or the other. It was usually carved in low relief, though at times it displays the tendency, which developed later, of becoming undercut and exaggerated. Contemporaneous with this, in France, the Gothic architect was carving a leaf ornament similar to Fig. 66. The motive is almost circular and the character is not free and open like the former, but

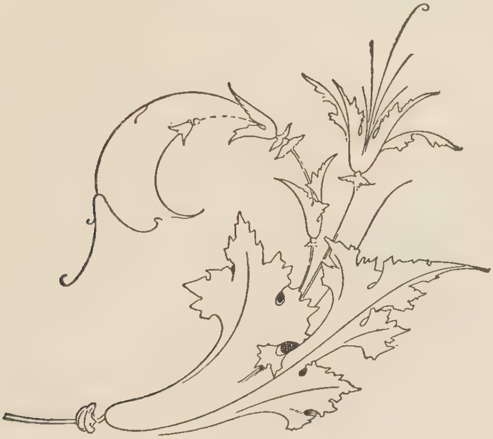


FIG. 65.

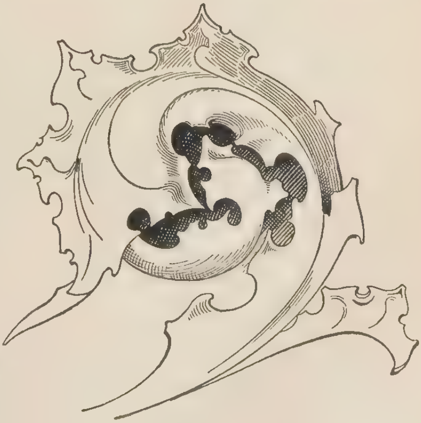


FIG. 66.

cramped, contracted, and apparently restrained by some fixed rule. The branching edges of the leaves show a partly controlled tendency to open out, as they did later, in the flamboyant period of French Gothic architecture, but as yet have not done so.

Thus, when the Italian architects imported by Francis I turned their wild, free, voluptuous designs over to the Gothic stone cutters, the latter could not execute them without curbing some of that freedom and reducing the form to some of their ideas of governing rules. Hence, we see in the early part of the period of Francis I a leaf ornament somewhat resembling that shown in Fig. 67, which is the Italian leaf cut on Gothic lines.

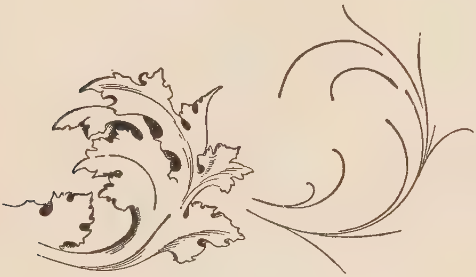


FIG. 67.

**41.** During the reign of Henry IV, the ornament expanded and approached more nearly the Italian form. It never lost its tendency to curl up tightly, however, and all attempts to relieve it of this tendency were failures. By the time of the reign of Louis XIV it had become even

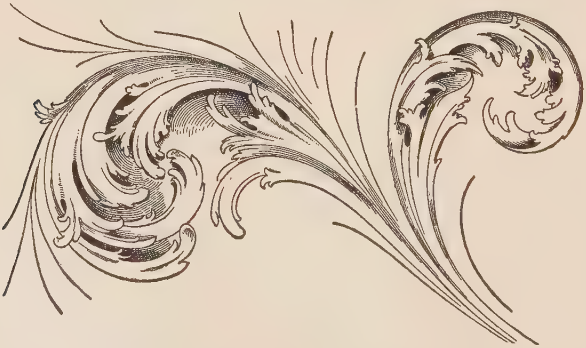


FIG. 68.

more free and luxurious than its Italian prototype, and its use, no longer confined to arabesques on friezes and pilasters, extended to the ornamentation of picture frames, furniture, candlesticks, and to every utensil imaginable in household use, as well as plaster mural ornaments and jewelry. Fig. 68 shows the character of the ornament at this time, while Fig. 69 shows its form during the reign of Louis XV, when it had reached the full extent of its meaningless development, generally known as *rococo*, a French term signifying frivolous. It became a trifle more intelligible during the

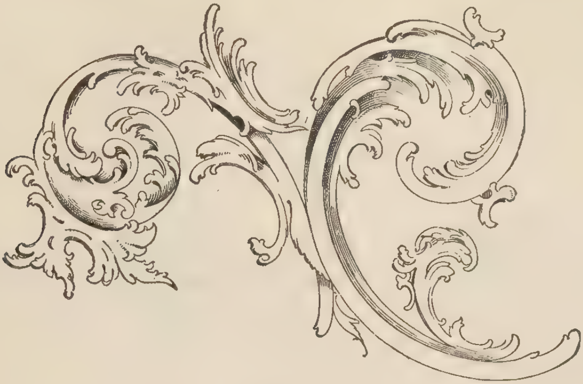


FIG. 69.

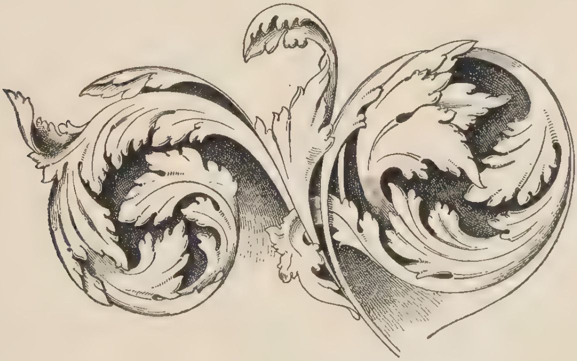


FIG. 70.

reign of Louis XVI, as the leaves were then more clearly defined, but the extravagances of its lines and curves never abated, as shown in Fig. 70.

Rococo ornament pervades all French Renaissance work to a greater or less degree, except during the period of Francis I. Fig. 71 shows the ornament as applied to the legs of a small table in the Louis XIV style, while the three-branch candlestick in Fig. 72 shows the rococo design carried to its most exaggerated form.

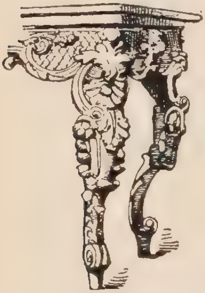


Fig. 71.

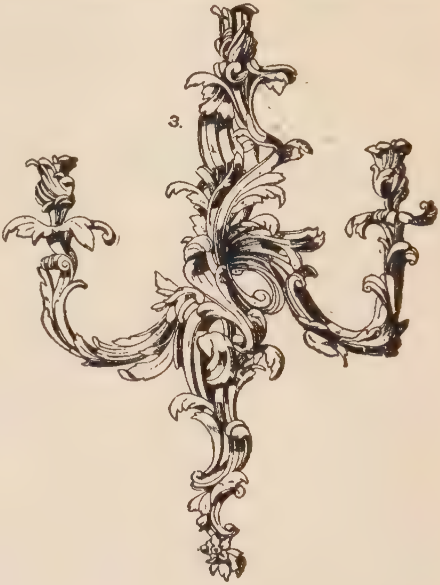


Fig. 72.

## ENGLISH RENAISSANCE.

**42.** The close of the Francis I period in France corresponds in date 1559 A. D. with the beginning of the Elizabethan period in England; but, as each of these styles marks the transition from Gothic to classic forms, they are usually considered as contemporaneous.

The Elizabethan style can hardly be considered as successful as its French contemporary, and its immediate successor, the Jacobean style, has nothing to recommend it. The age of Elizabeth, as the early part of this period is frequently called, is very important on account of the great advance in residence and educational architecture, but, unlike the preceding architectural period, it is entirely devoid of any ecclesiastic structures of importance.

**43.** In describing the character of Elizabethan ornament, a comparison of the circumstances of its birth with the circumstances of the advent of the more successful French style, is desirable. In France, the classic details mingled with the Gothic forms very sparingly at first and were imported direct from Italy, the land of their origin, while in England the intermixture was excessive from the beginning, and the classic designs were borrowed, not only from Italy, but also from France, Netherlands, Germany, and other localities, after these countries had already modified and corrupted them.

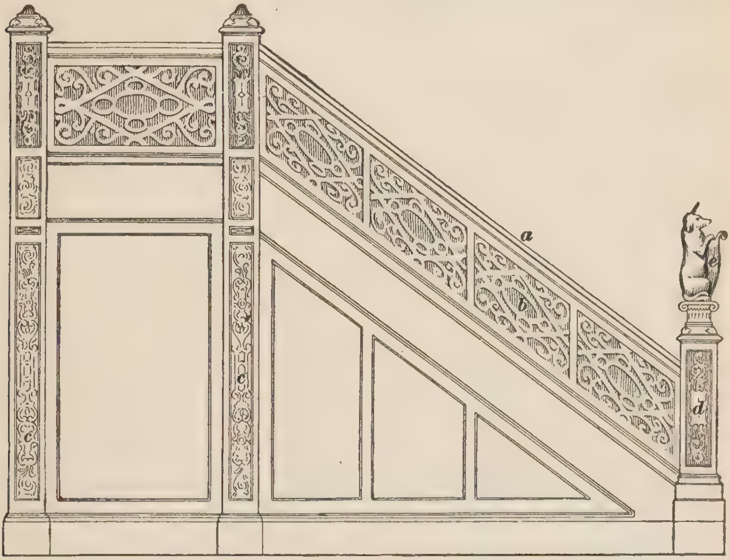


FIG. 73.

The Gothic system of construction was entirely opposed to the classic detail, and the ornament of this period is, therefore, applied to the surface rather than formed with the construction; and, when details from the orders could not be applied as ornament, the architects invented forms which were as meaningless as they were inappropriate. Elizabethan ornament, therefore, presents to us a grotesque and complicated variety of pierced scrollwork, as shown in Fig. 73, where the stair rail *a* is supported by the scrollwork paneling *b* cut out with a fret saw, the members being afterwards carved to form intertwinings. The ornament on the pilasters *c* and on the newel *d* is raised, the background being cut away to relieve it. A corrupted form of the Ionic cap used as a newel head is very common in this and the Jacobean periods, and is usually surmounted with a griffin or other grotesque animal supporting a shield *e*, on which is carved the owner's coat of arms. Besides this scrollwork, we see a great variety of interlaced bands, sometimes of a geometrical pattern, as in Fig. 74, but generally flowing and capricious; also, strap and faceted bands, as in Fig. 75, where pyramidal facets *a* and oval pateræ *b* are planted on the bands and give relief to the surface. Carved and broken outlines, festoons of fruit and drapery interspersed with human figures and grotesque monsters, and here and there a design of a leaf or branch constitute other types of this ornament. Where columns or pilasters were used, they were frequently square in plan, and often had a decided taper from top to bottom, as in Fig. 76.

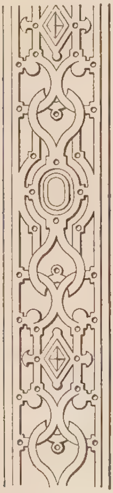


FIG. 74.

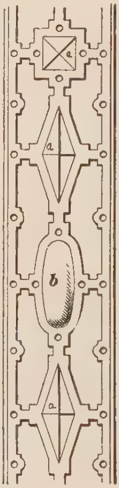


FIG. 75.

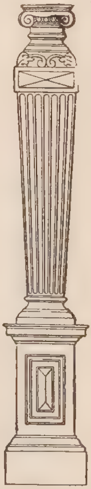


FIG. 76.

During the reign of James I these corruptions of classic detail were even more exaggerated. The orders were used to great excess, and were treated without correctness of position or grace of proportion, and the ornament was bold, heavy, and over assertive. In fact, English architecture was on a rapid decline, but was rescued by the revival of the Gothic at the close of the century.

Notwithstanding the paucity of the ornament and general design at this period, there is much to be learned from the general arrangement of the edifices; therein we begin to see the refining influence of advanced society, and the demand for household comfort and luxury.

**44.** This closes for the present the discussion of Renaissance ornament as it existed at the time of its fullest development in the sixteenth century. We have seen the classic forms interpreted by different architects, in different countries, to entirely different significations, according to the geographical position, methods of living, and system of government of each people.

**45.** Nineteenth-century, or modern, Renaissance should not, therefore, be an imitation of the style prevailing in Italy, France, England, or Germany during the period embraced between the years 1500 and 1700 A. D., as that style was in itself an imitation, and in many localities a very corrupt one. On the contrary, the modern design should be, as was the original Renaissance, an attempted reproduction of the ancient classic forms, adapted to existing conditions. As the parent style was governed by the influences of the fifteenth century, so should modern Renaissance be made to conform to the tastes, environments, and improvements of the nineteenth. In other words, the architect, in preparing his Renaissance design, should imbue himself with the spirit of a fifteenth-century designer, possessed with a knowledge of nineteenth-century conditions.

The spirit and principle of modern work would, therefore, be identical with the original style.

## NATURAL LEAVES AND BLOSSOMS.

**46.** From what has been said in the preceding pages, it should be apparent that, in the best periods of art, all ornament was based upon the principles which regulate the arrangement of form in nature, rather than upon an attempt to imitate absolutely the forms themselves; whenever this limit was exceeded, it was a most prominent indication of a decline in the art. True art consists in idealizing, and not in copying, the forms of nature.

At the present day, the tendency in art is towards the faithful reproduction of forms as works of ornament. The general public sentiment mistakes fidelity of execution for artistic value, when, as a matter of fact, true art exists in an ornament before the work is executed or even commenced. It is in the mental ideal that the artistic value lies, and accuracy of execution is to be commended only when it faithfully portrays the ideal, and not the type from which the ideal springs. The world is becoming tired of constant repetition of the same conventionalized forms, which are identified with the styles of the past ages, and therefore have little sympathy with the conditions of today, and a demand has arisen, that "we shall go back to nature" for an inspiration, as the ancients did. This advice is well enough in its way, but what shall we go back to seek? If we go back to nature as the Egyptians and the Greeks did, we may succeed in improving somewhat upon the present form; but, should we turn to nature as the Gothic artists of the fourteenth and fifteenth centuries did, we should gain little or nothing. As explained in Art. **26,** the ornament of the early English period was analogous to the Egyptian ideal; but the servile imitation in subsequent centuries destroyed the artistic expression.

**47.** By the ornament of a building, we can judge truly of the creative power possessed by the artist and expressed in his work. The general proportions of the building may be good, the moldings may be accurately profiled after the most approved models, the arrangements and subdivisions of the plan may be most ingenious; but the instant ornament is attempted, we can see to what extent the architect is an artist. Ornament is the best measure of the care and refinement bestowed upon the work. It is no easy task to put ornament in the right place, and in the right place only; and to express in the ornament the intention and purpose of the whole structure, is still more difficult.

In architectural practice at the present day, it is not unusual to leave in the hands of the draftsman the ornament of certain structural features of a building, and particularly the details of the interior decoration. By this means, much ingenious but decidedly inappropriate design is applied to certain details that do not require any ornamentation whatever, while vast surfaces of wall or roof are left bare, when a certain amount of surface decoration would relieve them. In Renaissance work, particularly, is ornamental form warped out of the true path and theory of applied decoration. The acanthus leaf, which is so prominent in Roman art, and carried from that into Renaissance design, lends itself so readily to the manufacture of ornament, that it has deadened the creative instinct in artists' minds. With the use of the acanthus, ornamental design has been so limited that the architect has left to another what appeared so simple to do, and thus abdicated his high position as architect and head and chief of the building operations. How, then, is the desire for progress to be satisfied? How is any new style of ornament to be invented or developed? It certainly is not dependent upon a new style of architecture, as it has been already shown that the desire for works of ornament is coexistent with the earliest attempts at civilization of every people—architecture adopts ornament, but does not create it.

**48.** The Corinthian order of architecture is said to have been suggested by the observation of an acanthus leaf growing around the outside of an earthen flower pot. The acanthus existed as ornament long before this order was invented, and it was a peculiar application of the leaf to the formation of the capital of a column that led to the invention and creation of the Corinthian order.

The principle of the foliation, and even the general form of the leaves which predominate in the architecture of the thirteenth century, existed long before in various illuminated manuscripts; and as these manuscripts were of Eastern origin, we can see an oriental character expressed in the early English ornament. The floral style, in direct imitation of nature, which succeeded early English architecture, was preceded by the same style in works of ornament. The facility of painting flowers in direct imitation of nature in the pages of manuscript, induced an attempt to rival them in stone, in the buildings of the time. The architectural ornament of the Elizabethan period is mostly a reproduction of the works of the weaver, the painter, and the engraver. The artists of the Elizabethan age were much more familiar with paintings, hangings, furniture, metal work, and other articles of luxury which England obtained from her neighbors on the Continent, than they were with the architectural monuments of ancient Italy, and it is this familiarity with the ornamentation of the period, but imperfect knowledge of the architecture, which developed the distinguishing peculiarities and characteristics of the Elizabethan style.

**49.** It may be argued, therefore, that an entirely new style of architectural ornament may be developed independently of a new style of architecture, and, moreover, it would be one of the readiest means of arriving at a new architectural style. For instance, if we could only invent a new termination for a column, or other means of support, one of the most difficult points in the determination of an architectural style would be accomplished. The structural features of a building which form an architectural style are: (1) the means of support; (2) the means of spanning the spaces between the supports; and (3) the formation of the roof. The decoration of these structural features forms the characteristics of a style, and as they all follow naturally from one to another, the invention of one would determine the rest.

The architectural profession of the present day is too much under the influence of past education on one hand, and an ill-informed public on the other, to effect a radical change in architectural style; but a future generation of both classes, born under happier circumstances, will develop what appears hopeless today. It is for the benefit of posterity that the present age is studying and copying works of the past; this servile copying will soon become irksome and lead to an architectural revolution, which will bring about a change in style.

**50.** In designing any ornamental form based on organic nature, it is best to assume a pictorial idea of that natural type in a conventional or geometric sense. A common dog rose and its leaves and buds have a certain geometric formation, which is characteristic of the flower and may be expressed in plan and elevation, so to speak, somewhat as shown in Fig. 77. At (*a*) in Fig. 77, is shown what we may consider a plan of the blossom; (*b*) is an elevation of the half-blown bud, and at (*c*) is shown an elevation of the closed bud; (*d*) shows the form of the leaves, their arrangement on the stem, and their relative sizes according to their positions. In expressing this flower in any form of ornament or decoration, the principles of its growth are all that need be expressed; an accurate portrayal of the details of the flower, in outline and color, is not high art, nor is its inappropriate application to a surface at all commendatory, no matter how well it may be conventionalized.

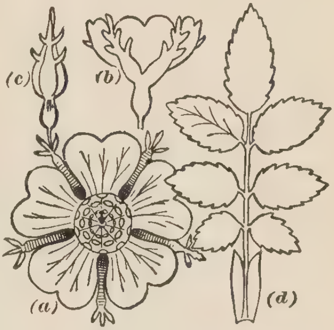


FIG. 77.

**51.** All flowers may be reduced to a similar geometric system, and after being geometrically drawn they can be conventionalized by eliminating from their portrayal every line not necessarily connected with the principle of growth, on which the flower depends. At (*a*) in Fig. 78 is shown a plan of the morning-glory blossom; at (*b*), a side elevation of the blossom; and at (*c*), an elevation of the closed bud. The twisted form of the petals in the closed bud never occurs as evenly in nature as in our illustration, but it is not the less a fact that in closing for the night, the petals of the morning glory, or convolvulus, assume a spiral position, which the form shown at (*c*) somewhat conventionalizes. At (*d*) is a natural outline of the pressed leaf, which is conventionalized sometimes into a mere isosceles triangle, and at others to a spear-head form, either of which shows the distinguishing characteristic of the leaf in its long, narrow, pointed form. The periwinkle, a flower similar in some respects to the one just described, is shown in Fig. 79. Its plan (*a*) shows the petals to be more independent of one another than in the plan of the morning glory, Fig. 78. Its elevation (*b*) shows the trumpet shape somewhat similar to the elevation of the morning glory, but flatter on top and straighter in the tube. The leaves are shown at (*c*), not in plan, as in Figs. 77 and 78, but in elevation, because their peculiarities and distinguishing characteristics are best seen in elevation, and it is in this form we usually see the flower conventionalized when used in any ornamental design. Fig. 80 shows the natural growth of the honeysuckle, while Fig. 81 shows the conventionalized elevation of the honeysuckle and its leaves. The usual irregularity of arrangement of each blossom is curbed into position and shape in Fig. 81, so as to form a geometrical figure. The leaves are treated in the same manner as were those in Fig. 79, though reference

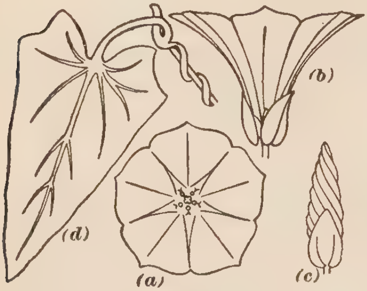


FIG. 78.

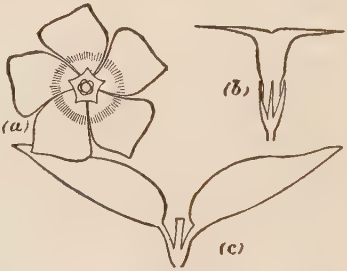


FIG. 79.

to Fig. 80 will show that they do not grow thus stiffly, though they do spring from opposite sides of the main stem, precisely as indicated. It would be a difficult matter to trace all the evolutions that Fig. 81 must have passed through in order to finally arrive at the shape of the palmette so characteristic of Grecian art. But, notwithstanding the remoteness of the conventionalized Greek form from the original type, the

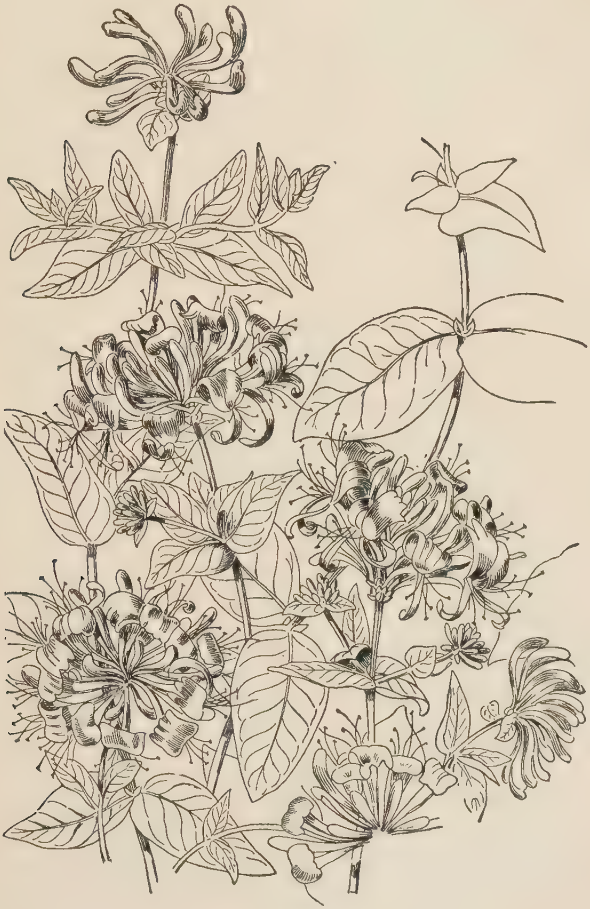


FIG. 80.

resemblance of the individual figures of the palmette may be traced to the petals in the elevation, Fig. 81.

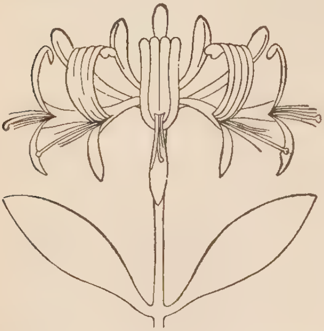


FIG. 81.

**52.** Fig. 82 shows a similar rendering of the passion flower, where the plan and side elevation of its blossoms and its leaves are brought into a design, to show its system of growth. The characteristics of the passion flower lie in its peculiar radiating petals, its raised and mushroom-like pistil, and the five-lobed form of its leaves. These characteristics furnish motives that may be easily conventionalized

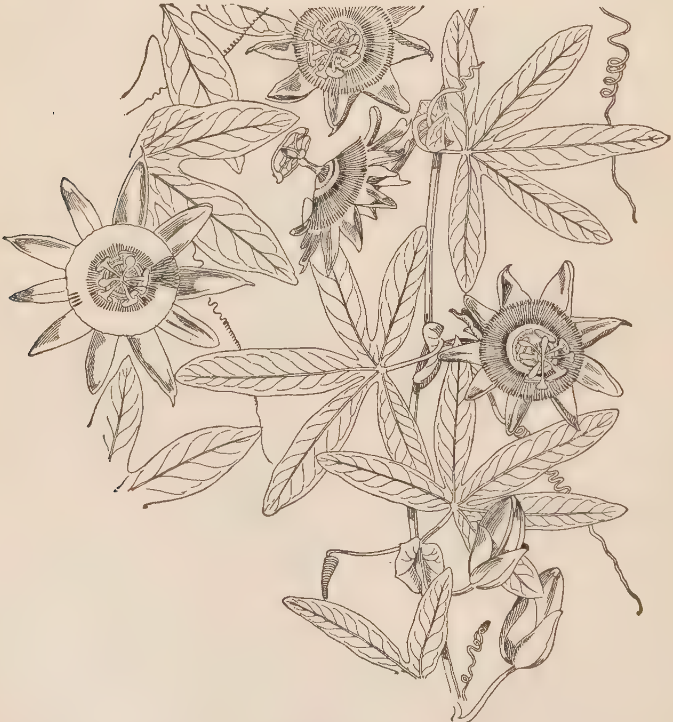


FIG. 82.

and lead to the development of an original scheme of ornament.

From these few examples, then, it should be apparent that it is entirely unnecessary for a modern artist to do anything but copy the five or seven lobed flowers so well patronized in the thirteenth century, or to imitate the honeysuckle of the Greeks or the acanthus of the Romans. All natural forms have unvarying principles, and by close observation of the principles, rather than the form itself, an original, true, and satisfactory end may be reached from our efforts.

## PRACTICAL PLANNING.

### INTRODUCTION.

**53.** The *practical* designing, the preliminary planning, and the original conception of the scheme of a building, are most important steps in the composition of a design, and require more careful deliberation than any other part of an architect's duties. These requirements mean more than simply arranging the requisite number of rooms on the drawing, crowding the greatest number of apartments into the smallest amount of floor space, and designing a picturesque elevation of the front. The *practical* plan comprises the most convenient arrangement of all the rooms and apartments necessary to the purposes of the building, the proportioning of these rooms to each other and to the whole structure, the simplest means of access to, and communication between, all apartments where such communication is required; and all this is to be so accomplished that the lines of the plan will be in harmony with the grouping and repose desired to be expressed in the elevations.

**54.** The architect requires to be thoroughly familiar, not only with the purposes for which the building is to be erected, but also with the character of the materials of which it is to be built. If the proposed structure is to be a church, then the architect must thoroughly inform himself on every detail and tradition of its service; if he is to design a hospital, then his knowledge of the requirements of the patients, of the duties of the nurses, and of the system followed by the doctors, will be severely taxed as he works out the plan; and it is certainly clear that, no matter how minute may be his instructions for the building of a mansion, no architect would be qualified to execute the work without an intimate acquaintance with the domestic and social habits of the upper classes of society. The successful architect must, therefore, be prepared to devote a liberal amount of time to the study of the *purpose* of the building, before he prepares the plans, or even conceives any definite idea of the arrangement or grouping of the parts.

**55.** The **purpose** of the building will very largely determine the architectural style of the design, and the style and purpose combined will suggest the material, although locality, climate, surroundings, and local conditions will generally determine the material. Art galleries, museums, civil government buildings, etc., whose purpose is the protection of valuable papers and records, are usually built in the *classic style*, and this style, combined with the permanency and durability required by the purpose, determines that the building shall properly be of stone.

If the purpose of the building is of a temporary character, as were the buildings of the international exhibitions at Paris, or at Chicago, the style might still be classic, but the material could be of iron and wood, finished and decorated with plaster, stucco, etc., as many of them were. However, if the structure is to be of stone, then the climate will determine the kind of stone best suited; the surrounding buildings or landscape will, in some degree, determine the color of the stone, and the hardness or softness of the stone will determine the amount of detail which may be cut in it, thereby influencing, more or less, the architectural style of the structure. Thus, we see that all this complexity of details must be judiciously considered before the plans are commenced.

**56. The Site.**—In *History of Architecture*, we read that the Walhalla, a beautiful model of the Parthenon, failed entirely in artistic effect, because its site was surrounded by the incongruous roofs and spires of the German villages, thus showing that locality, as well as purpose and material, should influence the proposed design. When a building, whatever its purpose, is erected on the summit of a lofty hill, or on the side of a mountain, without other surroundings than those provided by nature, its design should partake somewhat of the wildness of its position. It should appear strong, crude, and able to protect its occupants against the elements or invasion. On the other hand, when a building is erected in the bustling part of a busy city, surrounded by multi-storied office structures or factories, it should have the appearance of consistency with its surroundings, and should well express the purpose to which it is devoted. In private-residence architecture, the taste, social position, and disposition of the owner will materially affect the design, as will also the locality, whether city or suburban. Residences built in mountainous localities should be entirely unlike, in appearance, the dwellings along the seashore, and a house built in France would, of course, be entirely unlike a residence in America. Different countries, as well as different states in the same country, vary in the style and plan of their houses in the same proportion as they vary in the temperament and customs of their inhabitants.

## PROPRIETY OF STYLE.

### ITALIAN RENAISSANCE.

**57.** In nearly all countries it is customary to give preference, in residence architecture, to the style in which the dwelling house was originally developed in each particular country. In Italy, we see in nearly every modern residence some attempt towards the Renaissance in design. With the exception of Venice, Gothic art prevails in none of the cities, and even there it is so modified by local treatment that it is generally referred to as Venetian Gothic, to distinguish it from the French or English styles of the same period. In Rome, Florence, Genoa, and other important cities, the prevailing style is Renaissance, and, as has been said before, there is in the Roman school of Renaissance

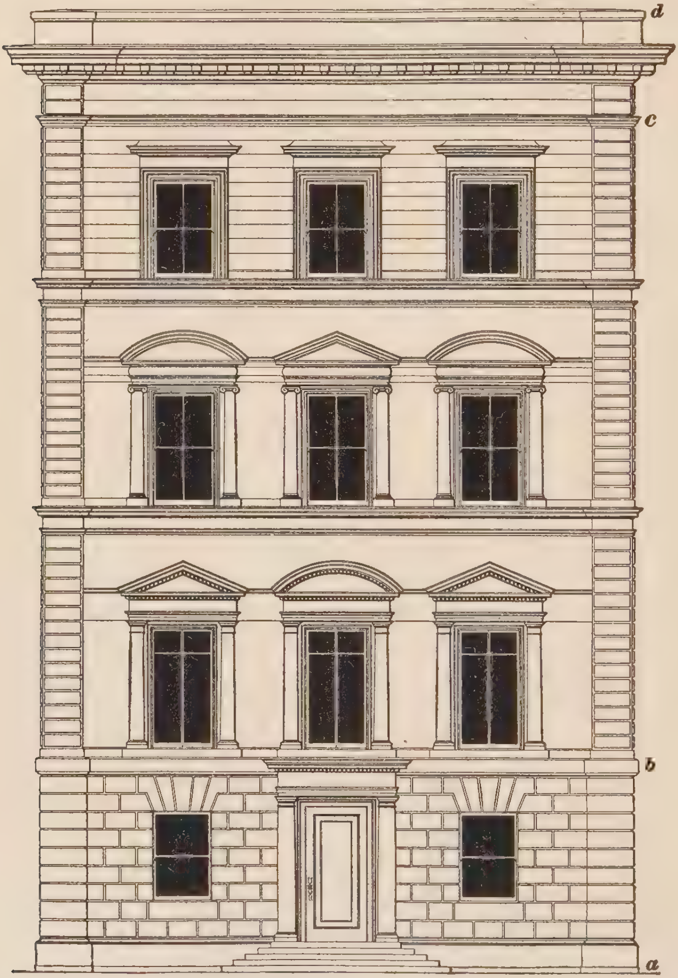


FIG. 83.

much that can be profitably studied in designing the modern city residence—whether it is the residence of an individual, as the private dwelling, or the residence of a number of individuals, as the hotel or club house. Fig. 83 is an elevation of the front of a residence in the style of the Roman school of Renaissance, and in Fig. 84 is shown the facade of the Century Club, in New York City, designed in the same style. The former of these exhibits the simplicity of arrangement of openings which can be made to give dignity and character to the front, behind which one can judge at a glance that there is a simple arrangement of rectangular rooms, disposed so that due advantage can be taken of the outlook from the front and rear of the building.

**58.** The treatment of the openings in the second and third stories of Fig. 83, with Doric and Ionic pilasters or semidetached columns, is characteristic of the Roman Renaissance; and this, combined with the alternating triangular and segmental pediments, is suggestive of the treatment of the facade of the Farnese Palace, shown in Fig. 94, *History of Architecture.* The contracted openings and the rusticated stonework of the first story are more in harmony with the Florentine school than with the Roman, but they suit their position here most excellently, as they give a solid and massive appearing base for the superstructure. The division of the facade into three component parts, basement *a b*, superstructure *b c*, and roof or cornice *c d*, is very nearly in the proportion of the pedestal, column, and entablature of an order

**59.** In the facade of the Century Club, Fig. 84, the conditions are entirely different, yet the same school of design suits admirably. Here we have a building apparently but two stories in height, the lower one being of heavy, rusticated stone blocks, with little or no ornament, while the upper story appears light in construction, rich in ornamentation, and symmetrical in design.

As a matter of fact, this building is not two, but four

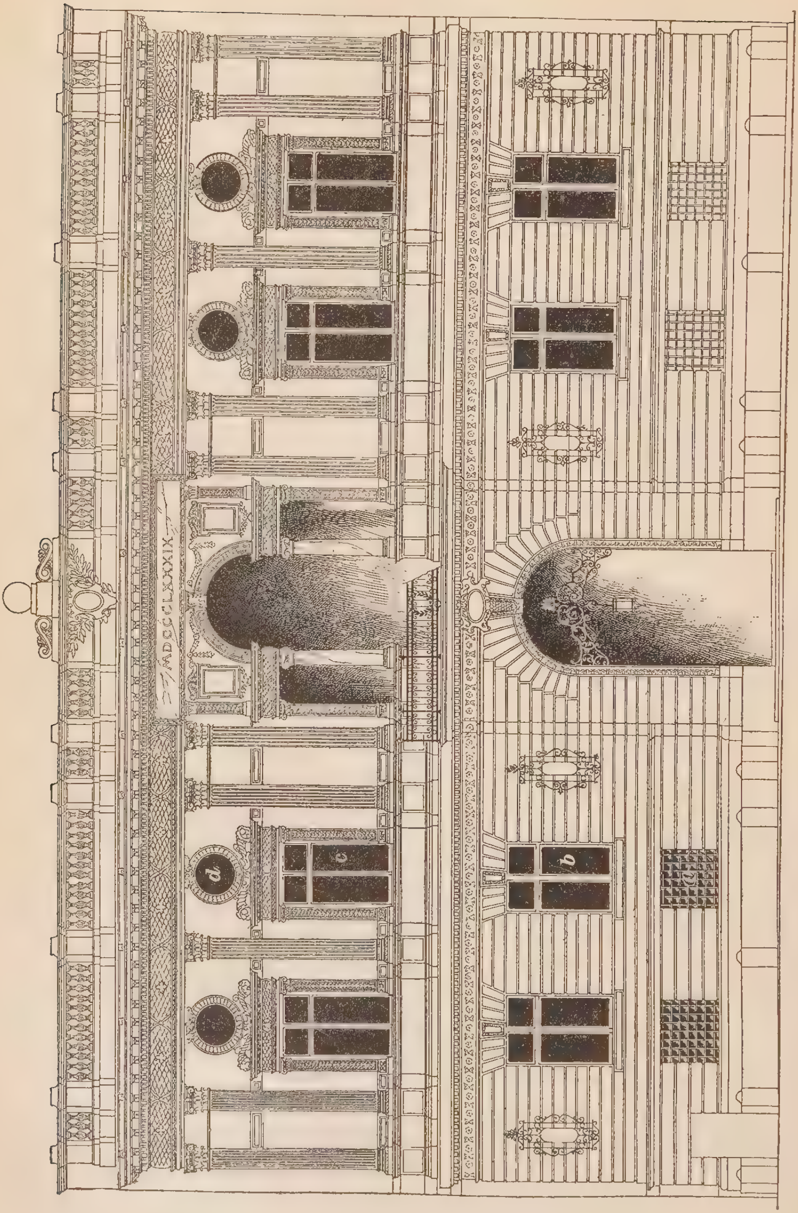


Fig. 84.

stories in height, and the requirements of the problem in design were that two of these four stories should have no prominence. In the first, or basement, story are located the business offices, coat room, lavatory, and other minor apartments, which were undesirable to express in the elevation, and which are lighted through the barred windows *a*. The second story, containing the reading room, smoking room, parlors, etc., is brought into prominence on the elevation and is lighted through the windows *b*; while the dining room and the library, occupying opposite ends of the third floor, receive their illumination through the windows *c*, and the circular windows at *d* admit light to the kitchen and servants' hall, which occupy one-half of the top floor, the other half being occupied by a gallery around the library. Thus, the second and third floors of the building are the only ones in which the visitor has any interest, and are consequently the only ones expressed in the elevation.

**60.** In the small private dwelling, where we require a less monumental design, the Italian Renaissance style is not so desirable, and more satisfactory results may be obtained by a Romanesque treatment, as the character of this style possesses the dignity of the classic, from which it grew, but at the same time expresses the economy of the Gothic, into which it merged, and is, therefore, more appropriate to the less pretentious dwelling. In other words, the Roman Renaissance is an appropriate dress for the monumental rooms of a mansion, while the Romanesque style is better suited to a residence where the privacy of home life is more conspicuous than the routine formalities of society. There are exceptions to this, however, in certain classes of work, which will be pointed out hereafter.

## FRENCH RENAISSANCE.

**61.** In France, the influence of the old feudal system can be traced in the plans and arrangements of the residence architecture even down to the present day. The house of

Jacques Cœur, as shown in Fig. 86, *History of Architecture*, possessed a large interior courtyard, which had for its prototype the inner bailey of the feudal castle, and is considered such an indispensable feature of the modern dwelling, that it is found today in connection with all French mansions, whether of ancient or modern design. Modern French residences are built mostly in the Gothic or Renaissance styles, the favorite appearing to be that period of Gothic which immediately preceded the introduction of the Renaissance, and that period of Renaissance which immediately succeeded or combined itself with the feudal Gothic—in other words, the style of architecture which prevailed during the reigns of Louis XII and Francis I. This style is particularly

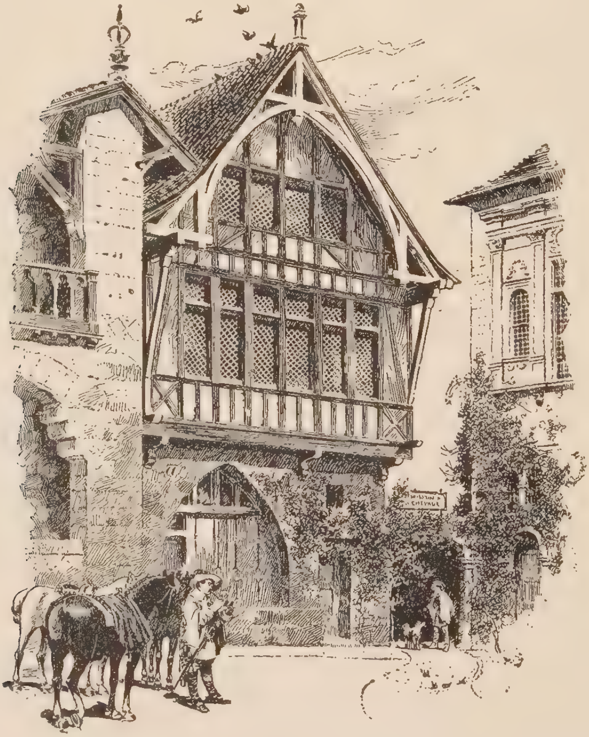


FIG. 85.

adaptable to city residences, and affords great opportunities for elaborate carving and exterior decoration.

In the rural districts, and even in the less aristocratic streets of Paris, timber-frame fronts, such as is shown in Fig. 85, are very frequent, and represent a style of dwelling much imitated in modern rural architecture. These buildings were frequently constructed of stone up to the second or third story, as shown at *a*, and then framed with heavy timbers one, two, and sometimes even three stories higher. Between the members of this timber framing, a filling of brick or rough plaster work was inserted, giving the structure a most picturesque appearance, and at the same time conforming with one of the strongest characteristics of the Gothic style; namely, *exposed construction.* In Fig. 85 every framing timber of the front of the house is exposed to view, and the necessity of the existence and position of each is apparent at once. With the advent of the Renaissance, the vertical members of this framing were often possessed of a capital and base, thus forming a series of pilasters; and though they lost thereby much of their structural significance, they enhanced the picturesque effect very considerably.

**62.** The great châteaux, or private mansions, of France, built during the early part of the Renaissance period, still adhered more or less to the ancient castellar form, even when erected in the cities. Fig. 86 shows the plan of the Château de Bury, near Blois, erected about the middle of the sixteenth century, and is typical of the general arrangement of the luxurious French mansion of that time.

Each corner of the building is guarded by a tower *a*, 25 feet in diameter, relics of the feudal, while two smaller towers *b* flank the porte cochère, or carriage entrance *c*. The walls *m*, connecting the towers *b* with those on the corners at *a*, enclose a large courtyard *e*, around which are arranged the apartments of the dwelling. On the opposite side of the court, at *f*, are the family apartments, with the principal rooms facing on the court, while at *h* are the servants' rooms and apartments, opposite the stables and offices at *g*. In the rear of the main building *f* is a garden *k*, with a chapel *i* at the back. The wings *g* and *h* are generally one story lower than the main building *f*, but the angle towers, which are nearly always round outside and square inside, are usually carried up to the same height. There is no essential difference in the general scheme of this arrangement and that

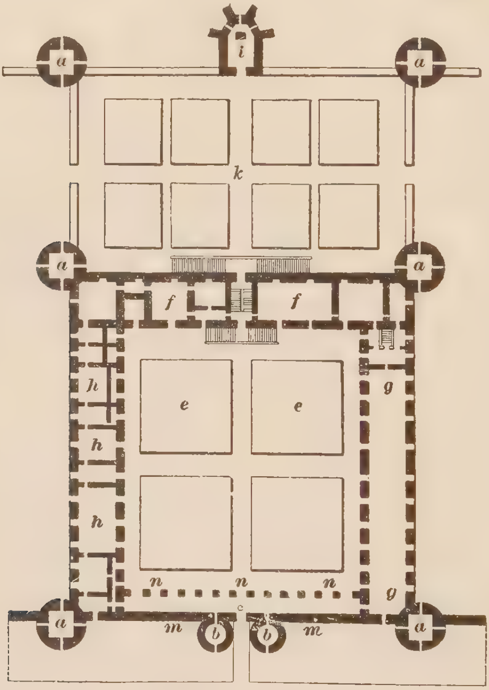


FIG. 86.

of the Château de Blois, Fig. 100, *History of Architecture;* but the rectangular outline of the plan, as contrasted with the irregular shape at Blois, is more in harmony with the exigencies of modern work.

Windows usually faced the garden and the court fronts, but none of the openings in the family apartments ever faced on the street, even when that wing of the house was built on the street front. The main front wall was never pierced by openings of any kind, except at the towers and porte cochère.

Behind it was a row of columns connected by arches, as at *n*, *n*, forming a covered arcade from the servants' wing *h* to the stables *g*. The towers were covered with a conical roof, and the parapet wall was sometimes castellated, and projected from the main wall on corbels, as shown in the old Château of St. Agil, Fig. 97, *History of Architecture*. The central part of the structure, containing the entrance door, was carried up a story higher than the towers, in order to give it emphasis, and was finished with a pyramidal or tent-like roof, from which this feature of the building derived its name of *central pavilion*—a prominent feature of the Louvre Palace, Fig. 127, *History of Architecture*. The dormer-windows in the upper story were usually finished with gables having concave sides and flat crowns, and flanked on the sides with pilasters. This style of gabled dormer is characteristic of the early French Renaissance, and may be seen in varied forms on nearly every château of this period.

The pilasters were repeated at the sides of the window openings in each story below, and their bases rested upon sill-courses, while their Corinthian capitals supported light string-courses, similar to the style of treatment in the Château de Blois, wing of Francis I, Fig. 103, *History of Architecture*. The walls were thus divided into a number of panels, each of which, in the second story, was decorated with a carved device representing a heraldic shield with a grouping of military weapons.

The basement wall was of rock-faced masonry battering on the exterior and plumb inside, while its window openings were small and devoid of ornament.

The cornice of the towers was battlemented—clearly an heirloom from the feudal castle, and used here simply as a symbolic detail. The towers also suggest the feudal period, and the only architectural forms which are novel to the structure are the Corinthian pilastered windows, and the regular, symmetrical, and systematic arrangement and balance of the details.

This type of the French mansion of four centuries ago is also the type of the French mansion of today; the only difference being that in crowded cities, like Paris, Marseilles, etc., the street front is usually occupied by stores, and the towers are either omitted in front, or are corbeled out above the first story, to avoid taking up the sidewalk space.

**63.** A peculiar feature of the structures of the Renaissance period was the symmetry of the plans. Nearly all buildings were perfectly rectangular, and were divided into equal wings and other subdivisions. Compare the plans of Fig. 87 of the Elizabethan period, and Fig. 86 of the Francis I period, with the wild, irregular outlines of the medieval castle in Figs. 84 and 85, *History of Architecture*, and while we can see a strong resemblance in the combination and arrangement of the parts, yet they are reduced and curbed to a foreign rule in the Renaissance work, while in the Gothic they are as free and untrammeled as the hills on which they stood. This point should be borne in mind when planning at the present day. If the design is for a mountain cottage, hotel, or sanitarium, let the outlines of its plan be as free as the land on which it is erected; but remember that, while a little natural irregularity is pleasing, too much of it offends good taste. Irregularity of plan should appear natural, as resulting from the surrounding conditions, and not studied or forced, as though to produce oddity of effect.

Many a building erected on a hilltop or hillside has been spoiled in its architectural effect by having received too much attention in the endeavor to render its lines symmetrical, instead of a proper amount of study towards fitting it to the contour of the ground it was to occupy. Gothic architecture is true and undeceiving; it boldly exhibits every detail of its own construction, and makes no efforts to hide the causes which necessitate irregularities of its plan. The Renaissance style, on the contrary, conceals its construction, or else makes great pretensions of constructive features, which examination will show to be but surface imitation. It may be beautiful, as in many instances it is, but it cannot be considered permanent, or even rational, building.

## GERMAN RENAISSANCE.

**64.** Owing to the scarcity of stone in Germany and Switzerland, we see more timber construction than masonry adopted for buildings, especially in the rural districts.

In the larger cities there are many handsome and pretentious residences, but in general character they lack purity of style, and can hardly be recommended as a type for the domestic structure of today. In the German Gothic style, the roof was large and very pointed, and frequently enclosed more stories than the walls below it. This was due to the fact that it was used as a drying room for laundry purposes, the large number of windows being necessary for the free circulation of air. The timber construction was expressed on the exterior of the buildings in the same manner as in the French work, but in many instances the floor timbers projected beyond the face of the building at each successive story, and the walls being erected on the extremities of these beams caused the house to be of larger dimensions at the top than at the foundation line.

Feudal castles existed throughout Germany as in France. Many of the finer mansions in the cities show their evolution from these medieval fortresses, and the castles on the Rhine stand today monuments of Germany's once great feudal strength; but in the Renaissance period the details for stone are contaminated with those of the timber construction, and it is no unusual thing to see a light, timber upper story, built upon a three or four story substructure of massive Gothic stonework, without any apparent reason for the combination.

## ENGLISH RENAISSANCE.

**65.** In Great Britain, the Gothic style has prevailed for all kinds of domestic architecture, and, like that of France, the favorite period appears to be the one when Renaissance art was first working its influence over Gothic forms. In England this is known as the Elizabethan period, and during its time the most comfortable adjuncts of the private residence were developed.

The Elizabethan period is also remarkable for the number of educational institutions that were erected, and this style of architecture, therefore, is most appropriately used in the designing of schoolhouses, colleges, etc. It was never originally used as church architecture, no large churches having been erected during the time of its development, but in some modern instances Presbyterian churches have been erected in the Elizabethan Gothic style, as Presbyterianism was established during the reign of the queen from whom this style takes its name.

**66.** The chief characteristic of the Elizabethan plan is the large, open hall *a*, Fig. 87—a legacy of Gothic times—which was paneled in oak to a height of 8 or 10 feet above the floor, as shown at *a*, Fig. 88. Above this paneled wainscot were arranged trophies of the chase, portraits and armor of ancestors, pieces of tapestry, and various other relics and heirlooms, as shown at *c*, Fig. 88. At the end of this hall was a carved oak screen *b*, Fig. 87, separating it from the entrance hall *c*, over which was the music or minstrels' gallery, a feature which is also a relic of Gothic days. A large bay window *d*, Fig. 87, the sill of which reached nearly to the floor, was a prominent feature of the center of the side of the hall,

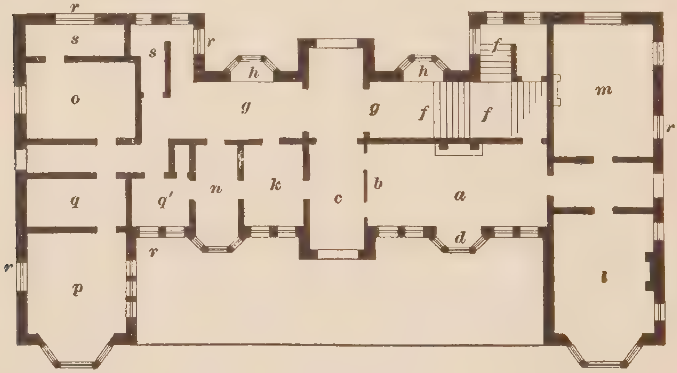


FIG. 87.

or often of the end, as at *b*, Fig. 88. The fireplace was very elaborate and was usually carved with the owner's crest or coat of arms, and other heraldic devices, as shown at *d*, Fig. 88. The ceiling of the hall was usually of open timber construction, as at *e*, in which the girders and floorbeams of the story above were exposed; or, when this part of the building was but one story high, the roof was of open construction, and frequently was elaborately carved. Next to the hall *a*, and entered from the entrance hall *c*, Fig. 87, was the great gallery *g*, extending nearly the entire length of the house, and one of the most characteristic features of the Elizabethan style. This gallery is very low and narrow in comparison to its length, but is relieved by immense bay windows *h*, which are often as large as an ordinary room. At the end of the hall was another prominent feature, the broad staircase *f*, the newels of which were richly carved, and the balustrade, instead of being a series of balusters, was generally an oak parapet pierced by numerous geometric forms, as shown in Fig. 73. Other rooms in the plan are the family dining room *k*, the state dining room *l* (a distinction now

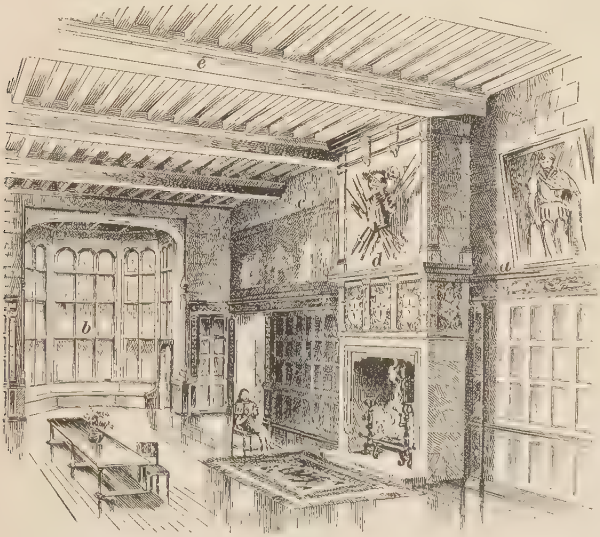


FIG. 88.

modernized by the use of the terms breakfast room and dining room); the drawing room is shown at *m*, and the smoking room at *n*. The kitchen is shown at *o*, and the servants' hall at *p*, while pantries were located at *q* and *q'*, and at *s* were the storerooms.

The windows *r* were large and numerous, but were subdivided by many mullions, while the glass was cut into small panes and was separated by strips of lead, as may be seen at *b*, Fig. 88. The bay windows were large and extended through several stories.

**67.** The gables of the Elizabethan house were irregular in outline, with alternating concave and convex quadrants of circles, as shown at *a*, Fig. 89, and were sometimes pierced by a circular window *b*, or ornamented with a cartouche or other carved device, as shown at *c*.

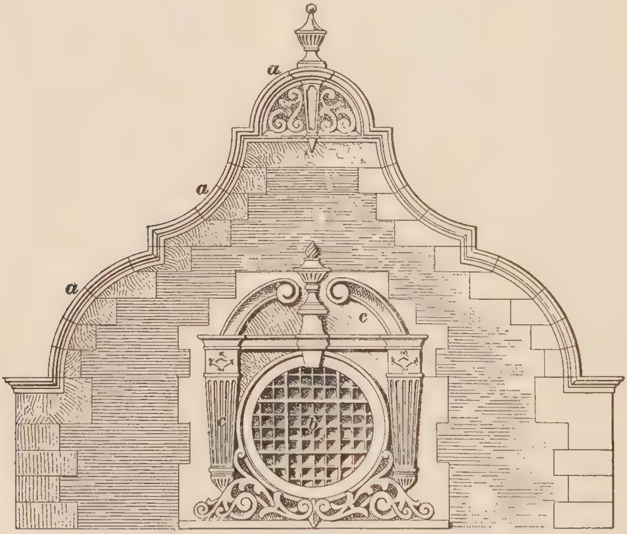


FIG. 89.

This style of gable was probably borrowed from Holland, for, though common in many Elizabethan houses, it is decidedly a Flemish detail. England was on very friendly terms with Holland at this period, the Flemish people having even offered the sovereignty of their country to Elizabeth, and it is not to be wondered at if details of Flemish architecture were popular in English art. This alternating convex and concave outline of gable is as characteristic of the Elizabethan period as the gable described in Art. **62** is of the period of Francis I.

**68.** Wooden architecture prevailed in the rural districts of England even more than in France, and after the Elizabethan period it was more debased in style than the more pretentious erections in stone and brick. During the period of the Classic Revival, the plans of the English dwellings lost all resemblance to the arrangements of the early Gothic days, and the houses were planned by crowding into a rectangle whatever rooms and apartments were required by the owner. The grand hall of Gothic days, the Elizabethan gallery, and the rambling, irregular passageways of the old English manor house, all disappear; and in their stead we have a rectangular plan, Fig. 90, with a wide hall *A* containing the stairs, and running through the center of the house from front to rear. The space on each side of this

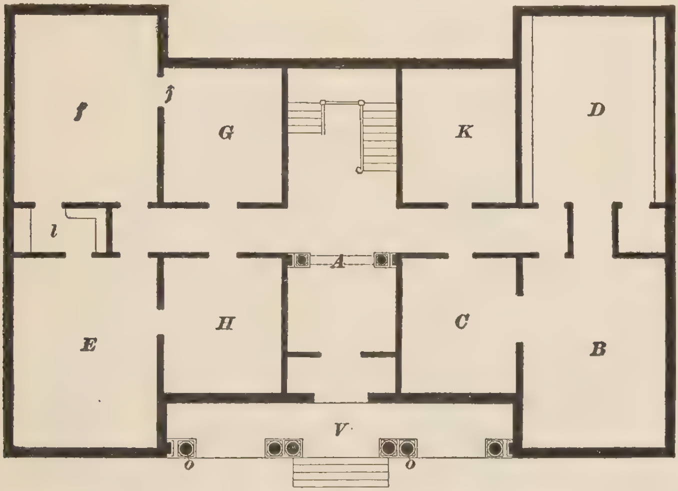


FIG. 90.

hall is divided into symmetrical and rectangular rooms, of which *B* is the drawing room, *C* is the parlor or reception room, and *D* is the library. The room *K* was sometimes designed as a smoking room, and often as a study connecting with the library *D*. The kitchen was at *f* and communicated with the dining room *E* through the pantry *l*, and with the servants' hall *G* through the doorway *j*. The room at *H* is the breakfast room or family dining room.

On the exterior, these houses had immense columns *o* extending through two stories, and supporting the portion of the roof which projected over the long porch, or veranda *V*. Or, in some cases, these columns were but one story in height, and the second story was carried out over the veranda and supported on them; or sometimes they carried an upper balcony over the porch *V*.

## EARLY AMERICAN RESIDENCE ARCHITECTURE.

**69.** To understand the style of domestic architecture most generally adopted in the United States, a more thorough consideration of the circumstances which led up to its formation must be considered. Unlike the homes and residences that were, in Europe, developed from a progressive alteration and improvement of the early fortified domicile, the houses in America were in the first instances most primitive, and were simple huts erected to protect the settler from the inclemency of the weather. Subsequently, as the colonies prospered and a feeling of permanency came over the colonists, a longing for the details of the European home caused the transplanting of the style prevailing in the mother country at the time of the American colonization.

The northeastern part of the Atlantic coast was settled in the early part of the seventeenth century by a colony of English Puritans, who came to America to avoid the persecutions which were practised under the English laws. Their residences were as close an imitation of their English homes as the materials at hand and the skill of their artisans could build, and their religious views being opposed to the amassing of wealth or living in luxury, their domestic arrangements were of the simplest kind.

However, the country was wild, and the dense, unbroken forests concealed unfriendly tribes of Indians that were liable to swarm into a new settlement and massacre the inhabitants without the slightest warning; so that nearly every village required at least one dwelling which should be of a more or less military character, to serve as a rallying point for the townspeople, where they could more effectually repel such onslaughts. One of these military residences, the old brick house of Governor Cradock, as shown in Fig. 91, was built in 1634, and is still standing. Simplicity marks the design; no use was made of the orders as in the prevailing revival period in England; it is simply a strong, brick, rectangular structure, with a few small windows and a massive iron-bound door that defied the attacks of the stone tomahawks of the Indians. The timber with which this house was built was hewn within a few feet of the site, and the bricks were burned on the premises. Iron guards were built into the doorway, and four suggestive loopholes *a* showed it was a military house from necessity, and a residence and trading post from choice. The other houses were of frame, or, in

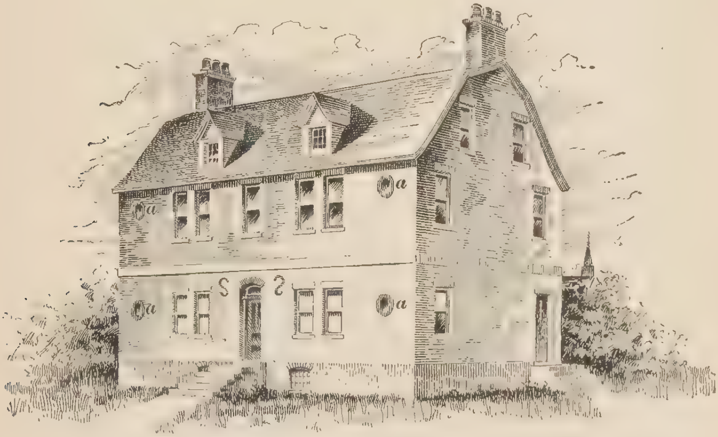


FIG. 91.

earliest times, of simply rough-hewn logs piled up like a cabin and shingled on the outside with hand-split shingles, which were secured in place with hand-forged nails. After the middle of the eighteenth century, many of the descendants of these first settlers, by dint of hard work and close trading, had, in spite of their religious sentiments, become very rich, and with their riches came the desire for splendor and luxury.

**70.** Nothing would be more natural than to turn to the mother country for ideas in architecture, especially as all the mechanics in the colony were men who had either learned their trades in Europe, or were the sons or apprentices of men who knew no other art than that evidenced in their English homes.

Hence, we see long two-story pilasters attached to the exterior angles of the house, supporting a heavy classic cornice and often a rich pediment with dentils and modillions, all of which were built of wood. Such was the Cragie House shown in Fig. 92, and also in Fig. 131, *History of Architecture*, built in 1759, at Cambridge, Mass., still standing, and, from 1837 to the time of his death, the home of the poet Longfellow. Here we see the symmetrical facade, the two-story pilasters, and the heavy, steep pediment so characteristic of the Classic Revival period in England; and,

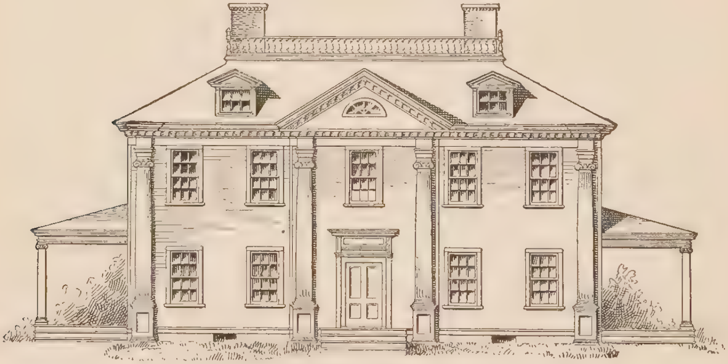


FIG. 92.

though singularly inappropriate in the American wilderness, these were details so popular that no important residence of the period was considered complete without them.

**71.** If we now turn to the southern colonies of the United States, which were also of English origin, a very different condition of affairs presents itself to us. The early settlers of this region, who were of aristocratic birth, came to America principally for commercial interests, and their religion, being that of the Church of England, interfered in no way with any desire of amassing wealth or property. They bought slaves and employed them in raising tobacco, the staple product. Essentially a countryman by preference, each of these early settlers loved above all things the comparative solitude of his great country home, with its dependent village of servants, farm hands, and mechanics, its stables filled with English horses, its barns filled with high-bred cattle, and its flourishing fields of tobacco and grain. The roads in this part of the country were mere bridle paths, as travel by any wheeled vehicle was almost unknown, and the negro slaves did all the work of harvesting the grain and tobacco, while the settler sat in the shade of his porch and watched them. Merchants and other tradesmen were, by these landed gentry, referred to as mere peddlers, and mechanics and artisans were scornfully called tinkers, as all commerce and trade was considered unbefitting a gentleman's calling.

The soil was very fertile, so that the planters were soon able to indulge in lavish hospitality, and leave to their servants and slaves the entire cultivation and disposition of the immense tobacco crop. Many of these settlers were the sons of prominent English noblemen, so that from the beginning of their existence the southern colonists possessed much taste and refinement, and as their hardships were few compared with the New England settlers, they could immediately turn their attention to the erection of comfortable dwellings, replete with those adjuncts of a luxurious and comparatively idle life which the possession of slaves enabled them to live. Thus, the gentry of Virginia were the first to introduce glass in their windows, while their New England cousins kept out the cold and admitted light through pieces of isinglass, bone, or bladder. The southern colonial houses were comfortable and substantial from the first, and the inherited desire for dignity and splendor is manifest in the Virginian settler's preference for a brick dwelling, in a country where wood was the most natural material and was everywhere abundant.

**72.** The style of these houses was a brick imitation of the early part of the Classic Revival in England. Plain brick walls with square-headed openings formed the block design of the structure, and this was frequently relieved of monotony by stone quoins on the corners and stone lintels over the windows, or a heavy wooden cornice with a wide pediment was carried across the top and was apparently supported by the heavy wooden pilasters which extended through two stories. The entrance was very prominent, being frequently a four-columned portico, and it usually opened into a large square hall, which, with its polished hardwood floor and generous open fireplace, gave an air of hospitality to the house, excelled in no other style.

Prominent in this hall was the staircase with a plain mahogany hand rail and white enameled balusters and steps. These balusters were very slender and could with more propriety be called spindles, while their form and design took every style and phase that the mind of the designer could devise. In New England the

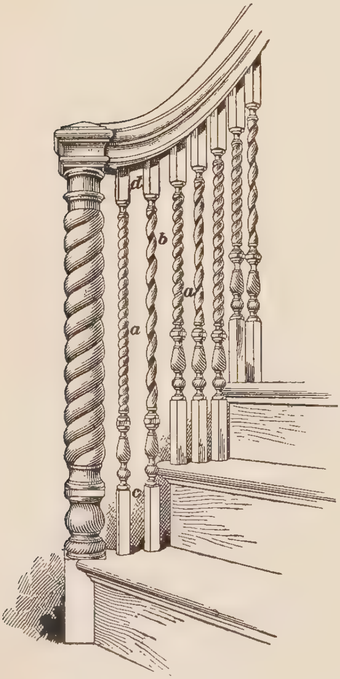


FIG. 93.

first hand rails were perfectly round, of any kind of wood that came handy, and the balusters were usually rectangular in section, about $\frac{3}{4}$ in. × 1 in. In Virginia, the hand rail was round on top, flat on the bottom, and hollow on the sides, worked from a selected piece of solid mahogany or rosewood, the balusters being turned in the form of a twisted rope, as at *a*, Fig. 93, or as a spiral spring, as shown at *b*, or having the appearance of an attenuated column; they always had a square prismatic section *c* at the bottom, and a similar section at the top, as at *d*. Two or more different designs of balusters *a* and *b* were often used in the same flight.

**73.** Before either of the foregoing colonial districts were established, New York state had been settled by the Dutch, and was called New Netherlands. It passed into the hands of the English in 1664, just fifty years after it was founded, but the Dutch had impressed so many of their characteristics upon the architecture, that for a number of years it did not entirely get rid of them, but at last the English elements prevailed, though in some parts of the state it was hardly felt at all.

The style of house erected in Massachusetts and in Virginia did not suit the Dutch settler at all. A long, low house, with the roof coming down to the top of the first story, and with one or two stories above, entirely under the slope, was much more to his liking. The phlegmatic Dutchman looked upon long flights of stairs as a nuisance, and his ceilings were high enough if they were nine feet above the floor, and there was no use of a second story if an attic would do just as well; his house, therefore, tended more to horizontal dimensions than to variations in height. Very little variety is encountered in houses of this period, and the only characteristic which remained to influence the architecture of later times was the stepped gable, which, though it occurred sporadically in New England, was here seen at every turn from the Hudson River in New York to the Susquehanna River in Pennsylvania. Towards the close of the eighteenth century the settlers, still retaining some of the Dutch details, began to lean towards the classic forms.

**74.** The system used by the Dutch government in Holland to colonize its American possessions, had marked influence on the architecture of this period. This government issued a charter to a company which was organized for the establishment of colonies in America. To any member of this company who would take or send fifty settlers to America within four years, this charter gave a tract of land extending 16 miles on one bank of a navigable river, or 8 miles on both banks of the river, and reaching back as far inland as he could occupy to advantage. The member received the honorary title of *Patroon*, and in return he agreed with his government to pay the expenses of the emigrant's passage from Holland, to stock a farm for him with horses, cattle, and agricultural implements, at small rent, and to provide a schoolmaster and minister of the Gospel. The settler in return made certain advantageous agreements with the patroon. In the vicinity of Albany, N. Y., a patroon named Van Rensselaer thus secured an estate of over seven hundred thousand acres. It extended on both banks of the river for a distance of 24 miles, and nearly twice that distance back, and additions were subsequently made, until the area of this vast domain exceeded that of the state of Rhode Island. Such a proprietor was richer than many a German prince. He was at once owner, ruler, and judge, and had not only a population of white settlers who were his servants and laborers, but also the promise of as many negro slaves as could be provided by the chartered company of which he was a member.

Thus, Killian Van Rensselaer, the first patroon, left to his posterity an immense estate, on which they built in 1765 to 1790 three magnificent manor houses, designed to equal, if not exceed, anything the colonies possessed. The resulting structures, two at Albany and one at Greenbush, near Albany, were classic in design, but influenced even at this late day by many Dutch details, both of interior arrangement and exterior treatment. One of these details was the dormer-windows on the Albany manor, which, though flanked by pilasters and crowned by a pediment, bore a strong resemblance to the typical Dutch New York City dormer, shown in Fig. 94. The roof of the Greenbush house was of the gambrel form so prevalent in Massachusetts, and the last one of the three, built in Albany in 1790, has a Palladian window, treated with an arch and two square-headed openings, similar to Fig. 34 of *Architectural Design*, § 21, over the entrance, and a denticular cornice supporting a railing or latticed balustrade around the roof, suggestive of the style used in Maryland and Virginia.

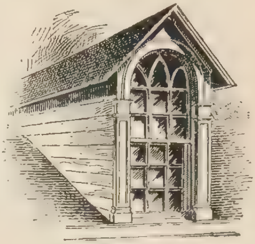


FIG. 94.

**75.** At the beginning of the present century, colonial architecture in the Middle and Eastern states had evolved into a combination of nearly all the early styles of building existing in America from the beginning of its settlement in the seventeenth century. In the Southern states, however, the style was influenced by foreign elements brought in as a result of the War of the Revolution.

In the year 1778, the king of France, Louis XVI, recognized the independence of the American colonists, and agreed to help them with both men and money in their war with England. This promise the French government fulfilled, and, as a result, the French people became very popular, and French forms, furniture, and details were introduced in many buildings repaired or rebuilt after the war.

After the assistance sent by France was received and the French forms and ideas became so popular in the country, the war became centered more in the southern part of the country, and the effect of this French influence is noticeable more particularly in southern colonial architecture; but, after the war was over, and the colonies became united into one country, the styles of the North and the South became intermingled, and architecture throughout the country became more uniform and systematic.

**76.** American architecture was then mostly a wooden imitation of classic forms, and the coloring was in nearly every instance pure white. Inside woodwork was painted several coats of white paint, each one of which was allowed to dry and was then thoroughly sandpapered, until the resulting finish was so smooth and white that it received the name of *ivory enamel.*

Though the general style of this period was the same throughout the country, there was an essential difference in the general planning between the houses of the North and those of the South.

**77.** Fig. 95 is the plan of a southern colonial house, of the type that prevailed in Maryland and Virginia, and is an American modification of the Elizabethan home its builder had left when he emigrated to the colony. Compare it with the plan in Fig. 87, and we see that if we remove the great gallery *g* from the Elizabethan plan, we shall have, in outline at least, a strong resemblance to Fig. 95. Let us analyze the interior arrangements in detail, and see how much further the similarity can be traced. The great hall *a*, the entrance hall *c*, and the gallery *g*, in Fig. 87, we find combined in the large entrance and stair hall *a*, Fig. 95. The colonial

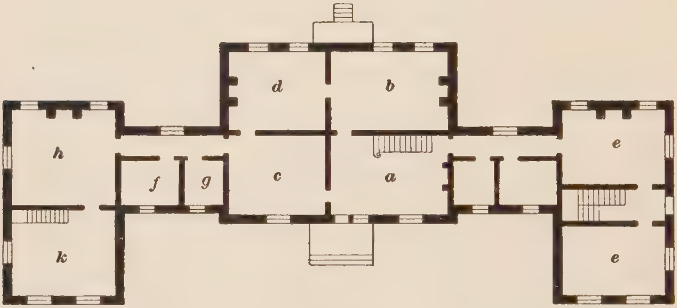


FIG. 95.

dining room *c* corresponds very closely in its location to the small Elizabethan dining room *k*, and though the parlor *b* and the library *d*, Fig. 95, are located in a position far remote from the similar apartments *l* and *m* in Fig. 87, this is easily accounted for when we take into consideration the difference of customs in the two countries. In the American plan, we have two rooms *e* which were used as reception rooms for guests and sitting rooms for the family, which are similarly located to the drawing room *l* and the state dining room *m* in Fig. 87, and again we see the kitchen *h*, the laundry *k*, the pantry *f*, and the storeroom *g*, all located in the same wing of the house in Fig. 95, as are similar servants' quarters in Fig. 87.

**78.** Fig. 96 is the plan of a house of the type that prevailed in the Northern states, and is clearly an offspring of the English arrangement shown in Fig. 90. The parlor *a*, library *b*, sitting room *c*, pantry *d*, kitchen *e*, and dining room *f*, in Fig. 96, are almost identical in their location with similar apartments in Fig. 90, the only strong difference appearing in the elimination of the servants' hall *g* and smoking room *k* of the English plan, and the moving of the

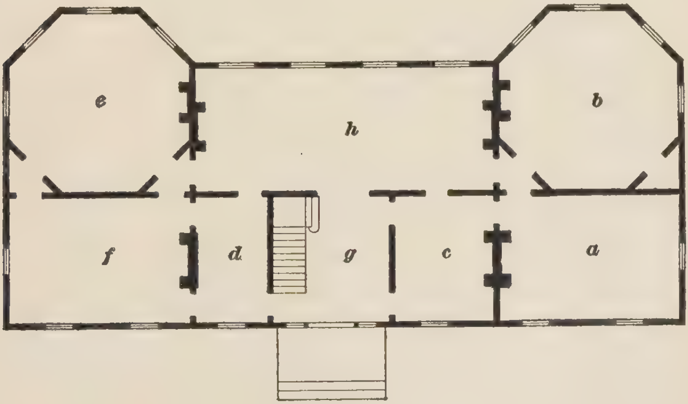


FIG. 96.

stair hall to the front of the house, thus converting the entire space occupied by these rooms in Fig. 90 into a grand reception hall *h*, Fig. 96. This reception hall was a characteristic of the American colonial residence. In this room, with its immense fireplace at each end, were held the formal state dinners which every man of prominence considered it his duty to give, at least once a year. Here, also, the figures of the stately minuet were executed with that military precision and graceful formality which so marked the manners of colonial days; the Christmas dances, the New-Year receptions, and the Twelfth-Night festivities, all took place in this immense reception hall of the typical New England home.

This hall *h*, opening, as it does, out of the paneled entrance hall *g*, and communicating with the parlor or withdrawing room *a* on one end and with the dining room *f* on the other, is traceable back through the Elizabethan period in England, even to the feudal ages, where the principal room of the castle was the great Gothic hall, which, as we have already seen, was afterwards separated into three apartments, the withdrawing room, the dining room, and the hall—precisely the arrangement we have in Fig. 96. In the earliest American homes, this reception hall served as parlor, dining room, and living room or reception room alike, and it is only after the beginning of the eighteenth century that we find the separation shown in Fig. 96. A singular parallel in circumstances makes this form remarkably appropriate when we consider it from a strictly architectural standpoint. The feudal lords of Great Britain and France built and fortified castles from which to defend their estates against invasion, while, in times of peace, their vassals tilled the soil and paid immense taxes or rents to the feudal landowner for the privilege. In the northern colonies, the Dutch patroon received taxes from immense tracts of land on which he had established a number of farming colonists, who were his vassals just as surely as were the wine growers and farmers of the thirteenth century; or, as in the South, the English landowner received the benefits and amassed wealth through the labors of his negro slaves, whom he considered his personal property just as much as he did his horses or cattle.

In each of the colonies there was at least one strong and partly fortified residence to which the inhabitants could flee and defend themselves at the time of an Indian outbreak. So we have very nearly the same governing influences in American colonies, at the close of the seventeenth century, that existed in Europe four centuries previous, with one great exception: the American colonists were laying their plans for peace and contentment, but the feudal lord fortified his castle for war and aggrandizement. As a result of this, the American manor is hospitable and open to all who come in peace, while the early Gothic dwelling was entered between turreted portals which frowned with suspicion and forbiddance on both friend and foe.

Thus we see the number and variety of elements which must be considered in laying out the design of a private house, which, as has already been said, is a problem to be solved in exactly the same manner, whether the house be the cottage of the frugal mechanic, or the palace of the merchant prince. The rooms of the plan are arranged to suit the convenience of the family that is to live in them, and the design of the details is executed to express the purpose for which the structure is built, and the period in history with which the arrangement of the plan or the tastes of the family are most nearly in accord.

Cost exercises a decided influence in any architectural problem, but cost should not be considered until the general scheme has been worked out to fit the requirements of the building.

## CITY HOUSES.

**79.** The private residence, as has been said before, is, like a man's coat, designed to fit his requirements, and not those of anyone else; the office building, theater, lecture hall, etc., on the contrary, are designed to suit a collection of people and not the tastes of an individual.

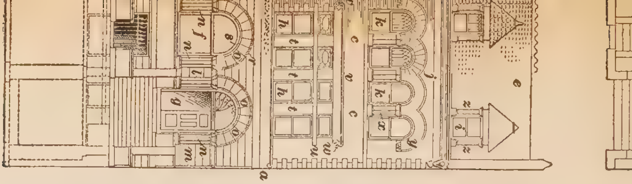
The private residence presents to the architect exactly the same kind of problem, whether the house is to be erected in the city or in the country. The former problem may be more complicated, owing to the restrictions imposed by a narrow lot walled in between two other buildings and permitting window openings and door openings to the proposed structure at the front and rear only, while the country house is usually open on four sides and is still further susceptible of extensive illumination of special rooms by the throwing out of a wing or large bay window; therefore, the rules just laid down governing the aspect of various rooms cannot be said to require strict adherence in an ordinary city dwelling, but they should be borne in mind and carried out as closely as the circumstances will permit.

The size, shape, and proportions of rooms will be governed by the same laws or circumstances, be the house city or suburban, but the position of the streets regarding the points of the compass will render it difficult, and perhaps impossible to have the light enter the principal rooms from the most desirable direction. Even this can be compensated in most cases, as the plans in Plate I will show.

**80.** This plate shows a set of plans for a city dwelling on a 25-foot lot, designed to suit the requirements of the following problem:

A member of an American legislature, possessing a large and valuable collection of books, desires a house planned with a spacious parlor, and a dining room on the first floor large enough to seat a dozen people; a library or study in a more or less secluded part of the house, and a nursery for his two children in the upper part of the house, particularly remote from the library, but near to or adjoining the nurse's bedroom.

Two large family bedrooms must be provided, and, on the top floor, sleeping accommodations are required for two female servants and the butler.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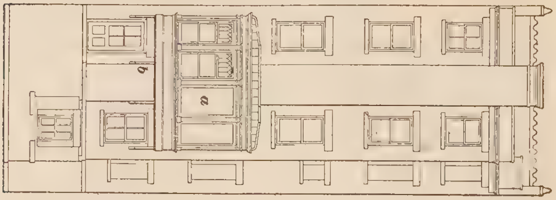
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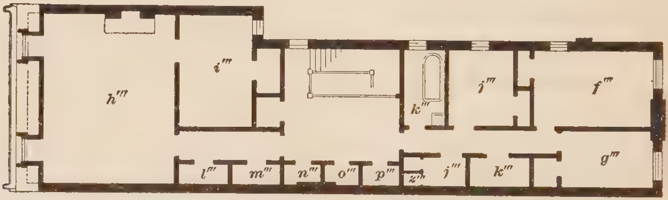
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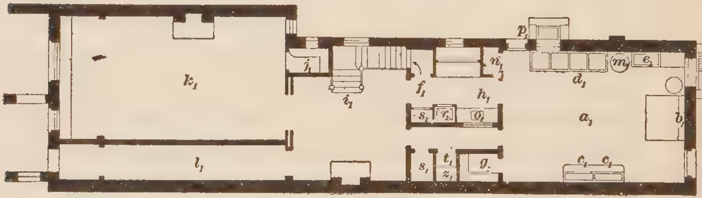
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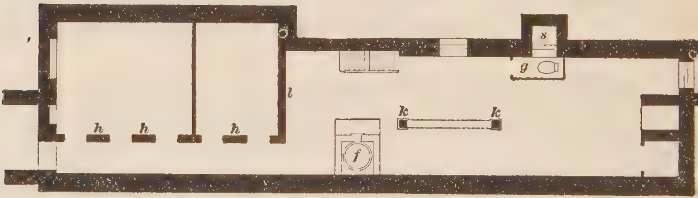
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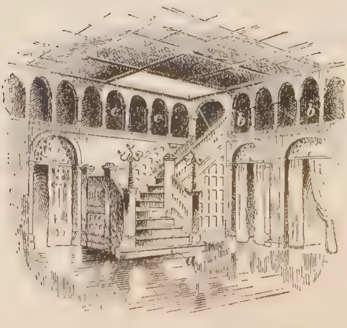
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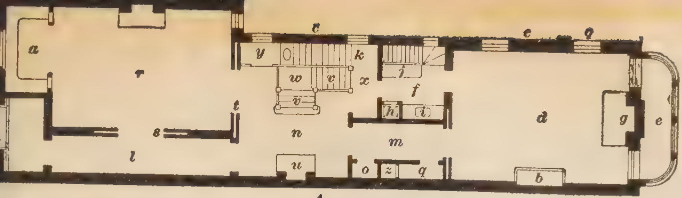
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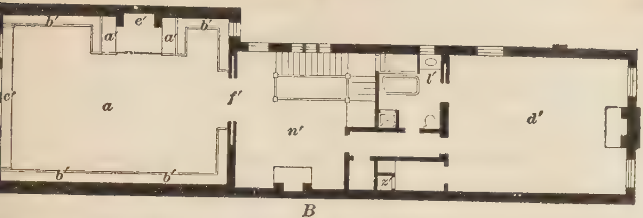
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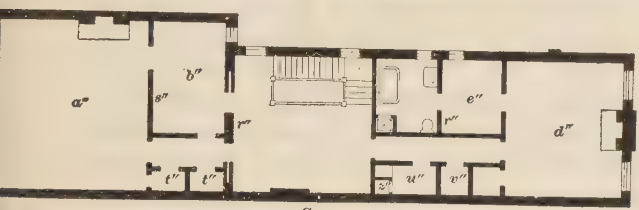
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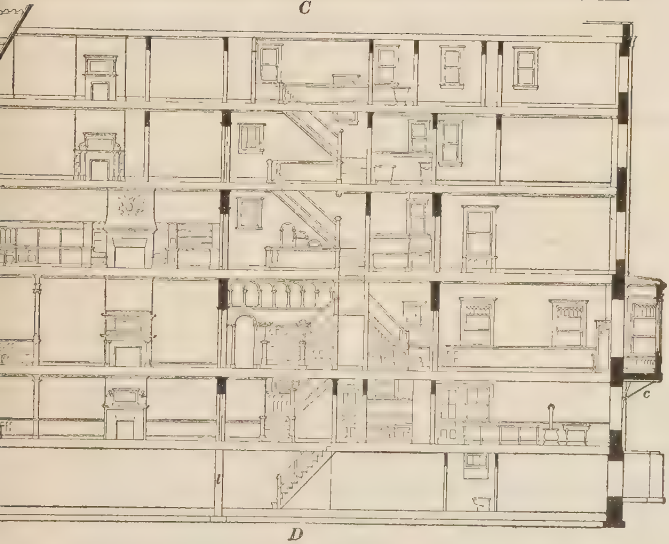
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**81.** In possession of this information, we will proceed to solve the problem before us. We are limited by a lot which is only 25 ft. × 100 ft., and the house can be lighted only from the two ends, as other houses are built close upon the lot line at each side. The house will be four stories high, and, therefore, will require walls 16 inches thick in the first story, and the inside width of the house is consequently reduced to 22 feet 4 inches. The dining room must seat twelve people, and, according to our rule, must be at least 19 feet long and 11 feet wide; but, to allow for furniture and a fireplace, we will add 5 feet to each of these measurements, and assume 16 ft. × 24 ft. as the proper dimensions to start with, which we may see fit to change if it crowds the plan too much. We will now make a rough, freehand sketch of the first-floor plan, drawing it to no regular scale, but simply blocking out at *D*, Fig. 97, a room of about the proportion of the dining room, and, on the other end of the house, a room *P* which occupies the position of the parlor. We cut off from this the hallway *h*, which would be about 5 feet 6 inches wide, and also the entrance vestibule *V*, and fit in between the parlor and the dining room the stair hall *H*, the pantry *B P*, and the private hall *p*. We calculate the minimum sizes allowable for each of these rooms in the same manner as we did for the dining room, and mark the determined size on the sketch, and with this freehand sketch as a guide, we proceed with the scale drawings shown in Plate I.

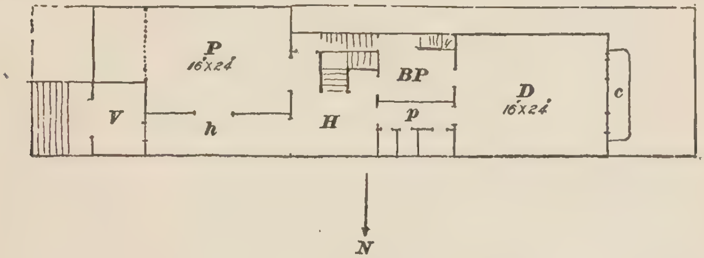

FIG. 97.

**82.** This illustrates the method used in the offices of architects in preparing and comparing all the preliminary plans. *A*, *B*, and *C* show the three principal floor plans, placed immediately over the longitudinal section *D*, so that the value and position of every partition may be seen in all four drawings at once; while at *H* and *I* are the front and rear elevations, so placed that the position of every longitudinal partition can be seen in the plan above and located behind the walls. Along the edge are freehand sketches *J*, *K*, *L* of nooks and corners and odd pieces of detail, the general effect of which requires study and consideration before they are worked into the plan. Any change in design or construction can thus be transferred from the plan in which it is made to each of the other plans, as well as to the section and elevation, and, in the reverse order, any change found necessary in the elevation or section can be immediately given its proper relation in the plans.

The determination of the proportionate sizes for the different rooms is arrived at by the methods given under the rules for planning each room; and, as the owner of this house is desirous of having accommodations for the entertainment of a dozen or more guests at one time, we must plan his dining room accordingly. His parlor or drawing room must also be carefully planned and proportioned to receive and entertain his guests after dinner. The parlor is, therefore, made the same size as the dining room, with the addition of a window seat at *a*; this, with the omission of the long table, which so fills the dining room, will give plenty of moving space on the occasion of an evening reception. Our rules for planning dining rooms require *that the exposure must be easterly, or southeasterly, and never towards the west.* But here we have a lot that faces directly east and west, and unless we place our dining room in the front of the house, we must apparently take our light from the west. At *A* is a plan of the first floor, which shows how we can arrange the dining room *d*. The minimum width of the dining room is 11 feet, but this one we have made 16 feet in the clear, between the walls, allowing 5 feet for the buffet *b* and other movable furniture; and, as our lot is 25 feet wide, we can have outside the dining-room walls a small light court *c*, which will also serve as a lighting and ventilating shaft for the central rooms. The window *q* admits light from the southwest, while the strong western sunshine, which is so objectionable at the time of the evening meal, is tempered by passing through the conservatory *c*. The buffet *b* is so placed that it will be well illuminated by both lights, and so fits another desirable condition laid down in our rules. The fireplace *g* is conveniently placed at the end of the room and serves in this position to keep frost from affecting the plants in the conservatory *c*. At *f* is a butler's pantry with its dumb waiter *h* connecting it with a kitchen pantry below, and *i* is a sink for washing the fine china, while *j* is the closet where this china is kept. At *k* are stairs to the kitchen below, by which the butler has access to the kitchen at all times. The dining room here is not situated upon the entrance thoroughfare, which is at *l*, but upon the private family thoroughfare *m*, near its junction with the public family thoroughfare *n*. A careful comparison of these details with requirements under the rules for a dining room will show that it conforms as closely as can be expected under the circumstances.

**83.** Our next consideration should be the parlor *r*, and after allowing 5 feet 6 inches for the clear width of the entrance hall *l*, we have for the width of the parlor 16 feet, and by making it 24 feet long, we get a room the same size as the dining room, which conforms in its location to rule 1 of our directions, but is not in accordance with rule 2 as regards its shape.

This, however, is not necessary, as the room can be considered as a drawing room and will be found to conform to rule 3. Much can be accomplished by the addition of the little window alcove at *a* and the placing of the fireplace in the center of the room opposite the door. This latter feature practically divides the room in half and would serve to separate guests into the informal groups required by rule 3. The impossibility of having a window here looking towards the sunset is too evident to require explanation, and even though it were possible, it is more than probable that the houses on the opposite side of the street would cut off any such view. The wall spaces are well arranged for picture hanging and the sliding doors at *s* and *t* admit of a treatment with portières which will be of much value in furnishing the room.

**84.** The stair hall *n* is placed in the center of the house in this case, in order to utilize the best lighted portions for the more important rooms. The arrangement of the stairs is studied with a due consideration of the interior effect, and the mantel and fireplace at *u* are introduced more with this idea than for actual service and use.

The prominent structural features of the hallway are the stairs *v* and landing *w*, and we therefore make these structural necessities the very means of our interior ornamentation. The height of our ceiling in the first story is to be 12 feet, and if we then allow 1 foot for the thickness from the ceiling to the second floor, we have 13 feet of altitude to be overcome by the stairs, for which 22 risers will be required. These we dispose in three short runs, in order to reduce the exertion required by a long tedious flight, and, also, to add picturesqueness to the hall. Having arranged the first run of five risers *v*, and planned to have an open balcony at the second landing *x*, we find it advisable to make a little sketch *J* of the interior effect of this stair and balcony landing, in order to get an idea of the full force of this treatment in the hall. At *J* is shown the appearance of the stair hall as viewed from a point somewhere near the door as we enter it from the hall *l*. In this sketch, shown at *J*, we have the first run of five risers *a*, and the balcony above referred to exists behind the arches *b*, while the arched openings *c* are carried along to cover the third run of the main stairs which extends from the balcony to the second floor.

**85.** Having found this arrangement satisfactory, we now proceed to the second floor *B*, and in the front of the house, at *a*, we locate the library.

The library we will consider in its stricter sense, that of a literary workroom, such as might be required by a lawyer or an author, and it is for this reason that we plan it on the second floor of the house. The walls are lined with the bookcase *b′*, and a window seat is built in at *c′* in lieu of the desirable bay window described in our rules for the library plan. The privacy demanding the placing of this room on the private family thoroughfare, is accomplished by its situation at the head of the main stairs and its entrance on the family hall *n′*. On account of the economy of locating all the plumbing fixtures over one another, the nearest point at which we can place the lavatory is at *l′*, but as the only other room on this floor is the bedroom *d′*, complete privacy can be maintained at all times. The interior walls in the front part of the house are built with brick to the top of the library ceiling, and the library floor and ceiling, and the floor of the parlor and hall *b*, are constructed with iron beams and terra-cotta blocks, to insure the safety of the books and papers in event of the house taking fire, while metallic sheathed doors at *f′* shut off the hall and stairs.

The interior finish of the library is made effective by means of the artistic arrangement and treatment of the bookcases *b′*, and after making a preliminary sketch at *K*, we decide to include in the arrangement a chimney seat *a′* placed on each side of the fireplace *e′*. The details of this seat and the final treatment of the mantel and bookcases are all left for future consideration, but the general paneling of the woodwork is expressed in the sketch *K*. This sketch is assumed to have been made before the plans are fully developed, so that the subsequent insertion of a window over the bookcase has not been embodied in the sketch. A similar sketch *L* shows the effect of the dining-room mantel and conservatory doors, and also gives us an opportunity to study the treatment of the walls and windows in the room before we finally locate them on the plan.

**86.** On the bedroom floors, we are governed very much by the location of the partitions on the floor below; so that we first draw the partitions *r″* over the divisions at each end of the stair hall, and thus have a bedroom $a''$ in the front of the house which would be about the same dimensions as the library below, but this being unnecessarily large, we subdivide it by the partition $s''$ and provide a dressing room at $b''$ and two liberal closets at $t''$.

The plumbing fixtures below necessitate the location of the bathroom on this floor directly over the bathroom on the floor below, while the rear room at $d''$ will be a desirable location for the nursery, and $e''$ a room for the nurse. Along the north wall at $u''$ and $v''$ can be arranged closets for linen, brooms, dusters, and other articles necessary for household use.

On the top floor $E$ will be located two servants' rooms $f'''$ and $g'''$ over the nursery $d''$, and also one large extra family bedroom $h'''$ over the chamber $a''$, while over the dressing room $b''$ can be located a small bedroom or a storeroom $i'''$. Abundance of closet room should be supplied on the top floor, as at $j'''$, $k'''$, $l'''$, $m'''$, $n'''$, $o'''$, $p'''$, etc., for the storage of trunks, boxes, and household ornaments during the summer, or for awnings, furniture covers, screens, blinds, etc. during the winter.

**87.** From the top floor we go to the basement plan shown at $F$, where we provide a large kitchen $a_1$ under the dining room, and place the range at $b_1$, sink at $e_1$, dresser at $c_1$, and a large storeroom, with shelves for packages, groceries, etc., at $g_1$. A pantry $h_1$ contains all the dishes necessary for the servants' use, and a sink $o_1$ provides a place to wash them without interfering with the kitchen sink at $e_1$. Along the wall at $d_1$ are arranged four washtubs, with the laundry stove at $m_1$, and a closet for the laundry materials at $n_1$. The door at $p_1$ gives the laundress opportunity to carry the clothes into the drying yard without interference with the cooking arrangements at the range $b_1$.

The pantry $h_1$ contains the dumb waiter $r_1$, which communicates not only with the dining-room pantry, but also opens on each floor of the house, and can be used to take meals up to any of the bedrooms in case of sickness, or to carry coal, wood, or other fuel for the open fires in any of the rooms upstairs. Stairs at $f_1$ communicate with the cellar, and at $i_1$ the main stairs go up to the landing shown in the first-story plan *A* at *k*. In the front of plan *F* we have a large room $k_1$, which may be used as a servants' hall, and at $l_1$ is a passage communicating with the street, where tradesmen can enter and deliver their goods.

**88.** In many instances where a servants' hall is considered unnecessary, the room $k_1$ is fitted up for a billiard room, although it is not as desirable a place as would be any room on the top floor, where a skylight could be provided. At $j_1$ is a closet for the reception of table linen, etc. used in the servants' hall, while at $s_1$ are closets for the storage of sundry necessities of household use.

On each of the floor plans, except the cellar *G*, there is shown at *z* a *chute*, or shaft, which is open from the top floor to the basement, and is used for the transfer of clothes from the various bedrooms to the laundry. As the chambermaid arranges the rooms, or changes the bedclothes in the morning, she simply folds up the soiled linen and drops it down to the basement closet, where it is afterwards collected and washed by the laundress. This device avoids the necessity of carrying the soiled linen down stairs, or of using the dumb waiter for it, which would require the attention of another servant below to remove it as it was sent down.

The cellar plan *G* contains the furnace *f* and a water closet for the servants at *g* with its ventilating shaft, shown at *s*. In the front are bins for the storage of wood and coal; the piers *h* and arches between them carry the wall between the servants' hall and passageway in the basement, and the wall between the parlor and entrance hall in the first story; the piers *k* and girder supported by them carry the partition, against which the dumb waiter runs from the basement to the third floor.

**89.** We have thus analyzed each floor plan separately, and have considered the necessities of each story as we came to it, but that is not the way we should draw the plan itself. Our preliminary freehand-sketch plan in Fig. 97 has given us certain desirable arrangements and combinations to work from, but we cannot tell to what extent we can make use of them until we develop the scale plans, as shown in Plate I; and, as said before, we can only arrive at the most satisfactory results by giving the closest study to the effect of each feature as it is introduced into the plan. A concentrated study is best secured when all the floor plans, sections, and elevations are drawn on one sheet.

Plate I is a reduced copy of a regular office set of preliminary studies, drawn to a scale of $\frac{1}{8}$ in. = 1 ft., and the first, second, and third story plans *A*, *B*, and *C* are arranged in the manner shown, so that one can more quickly observe the relative position of the parts of each plan. The longitudinal section *D* is developed at the same time as these plans and for the same reason. In this way, when the stair hall *n* in plan *A* was being laid out, we could immediately locate the second-story hall in plan *B* and the third-story hall in plan *C*, while the position of the stair landing and the arrangement of the stairs are immediately decided by drawing them on the longitudinal section *D*.

The same may be said of each of the other details of construction, in each of the other stories. The dimensions of the parlor *r* in plan *A* had to be considered not only in relation to the desirable proportions of that room by itself, but also in connection with the library *a* in plan *B*, as the partitions separating these two rooms from the stair hall had to be maintained directly over each other; and so on throughout the building, each room and minor detail could not be considered by itself alone, but rather in connection with some other detail either dependent upon it, or upon which it was itself dependent.

**90.** Up to this time, no windows have been located in the front wall, and the front elevation has not been carried on as rapidly as the plans. The reason for this was that no longitudinal partitions of importance exist on any floor, that will materially influence the treatment of the window openings in the facade. So that now, when we come to block out the front elevation, we have simply a plain wall 25 feet wide and from 60 to 70 feet high, whose character and expression are dependent upon the materials used and upon the *fenestration*, or window arrangement.

**91.** As to the architectural style to be exhibited in the elevation and details of this house, we must be influenced by the appropriateness of its application to the tastes and customs of its owner. Italian Renaissance of the Roman school is out of the question, as the house is too small to successfully carry such severe and monumental treatment. The style of Francis I would be appropriate, but its elaborate detail makes it expensive and beyond what we consider would be the most economical cost of our design; besides, this style is essentially French in its character, and the owner of the house is supposed to be more strongly identified with American sentiments than with those of any other particular country. Gothic architecture is not adaptable to *urban*, or city, buildings, except where such are located within extensive grounds, or on a water front, so that a sufficiently distant view may be had to observe the variety of detail and outline at one glance; Elizabethan is essentially English and not acceptable for the same reason that Francis I was rejected, and American colonial is best adapted to *suburban*, or country, work.

If we now consider the Romanesque, we will find in it none of the objections of the above mentioned styles, while it is particularly adapted to our desires.

Romanesque architecture is not associated with any particular country. It was practised in all civilized countries of the old world, but was slightly modified according to locality and circumstances. It is not necessarily expensive, as it can be treated with severity or elaboration, as desired, and can be executed in stone, brick, or timber. It is expressive, and while lacking the cold severity of the Grecian classic, it also avoids the plaster sham of the later Renaissance. Besides all this, it is appropriate to American structures, for it was developed in the European countries under conditions somewhat similar to those existing in America today.

**92.** We will, therefore, design the facade in American Romanesque. At *H*, Plate I, is the elevation as we finally complete it; the front wall to the top of the second-story beams is built with rock-faced ashlar, while the parlor window *f* and the main entrance *g* are each spanned by a bold semicircular arch. The arches have equal radii, and are separated by the pier *l*, and abutted by the piers *m*, of a width equal to *l*. These three piers *l* and *m* have each on the side next the opening three semidetached columns *n*, upon the capitals of which the voussoirs *o* of the arches rest, while the bases of the columns rest upon the sill-course.

Around the *extrados*, or outside line *r*, of these arches is formed a hood mold, while the *intrados*, or inside line *s*, is molded. The form of these moldings will be similar to those shown at *A* and *h* in Fig. 2 of plate entitled, Door and Window Treatment, *Advanced Architectural Drawing*. The style of the capitals of the columns is also shown on this drawing plate. At *a*, on the elevation in Plate I, is a sill-course finishing the ashlar front, upon which the brick wall *c* is started. This sill-course is molded in the form of a projecting quarter round with a fillet on each side, and is carved with an ornament similar to that shown at *B*, in the drawing plate above referred to. The windows *h* open into the library, and, in order to light the room thoroughly, they are extended up nearly to the ceiling; on account of this height the transom bar *u* is introduced, and the transom sash is glazed with leaded and stained glass so as to secure a more attractive interior effect. The piers *t* separating the four windows are of brick, but the transom bar is of stone similar to that of the first story, as are also the quoins at *b* and the lintel and the dripstone *v*.

This dripstone *v* is molded on top similar to the scroll moldings shown at *d* in Fig. 62, *Architectural Design*, § 21, but the under side of it is not so deeply cut and the ends are finished with a carved leaf, as at *w*, Plate I.

The windows *k* open into the principal bedroom of the house, shown at *a″* in plan *C*. These windows are separated by stone mullions *x*, upon the faces of each of which are carved two semidetached columns similar to those at *n* in the first story, but not so large or so elaborate. The arches *y* are of stone voussoirs similar to those at *o*, but molded on the extrados only.

At *j* is a stone cornice projecting slightly from the face of the building and forming at the same time a sill-course for the two dormer-windows *i*. These dormers are flanked on each side by a stone pilaster *z*. The dormer roofs are covered with tile, as is, also, the Mansard roof *e*.

The steps leading up to the entrance are flanked by a stone parapet in place of a balustrade, and this is carried along the front of the areaway, as shown at *p*. The dotted lines in the elevation *H* show the depth to which this wall is carried in order to secure a firm foundation.

**93.** The treatment of the rear elevation *I* consists of simply showing the openings on the outside, with a stone lintel above each of them and the wall carried up in plain brick. The conservatory *a* is projected from this rear wall and supported on brackets *b*, as shown also in the section *D* at *c*. The material of which the conservatory is built is iron—a skeleton frame covered with copper and filled with porous terra-cotta brick, to give warmth. The windows of the conservatory are as large as circumstances will permit, and the roof is of heavy ribbed or wired glass to admit all the light possible to the growing plants.

This completes the study of our preliminary sketch, and when it is approved by the owner, we start to make our working drawing on a scale of one-quarter of an inch to the foot.

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## COUNTRY HOUSES.

**94.** The planning of a country residence is, as a usual thing, much less restricted than in the case of a city house, but the questions of aspect, communication between, and location of rooms, at times so complicate the problem as to make the desired arrangement very difficult. Many of these country residences are erected by people who expect to occupy them only in the summer, and who have a town house wherein they spend the winter season. Life in these summer residences, or villas, as they are sometimes called, assumes a less formal character than in the urban houses, and the planning and furnishing should exhibit an expression of hospitality and welcome, rather than the stiff regulation required by the formalities of society in its winter abode.

**95.** We will now consider the problem of building such a residence for a family consisting of the owner, his wife, grown daughter, and two small children. The desires of the owner are for a large and hospitable entrance hall, with the staircase rising from it; a drawing room for the entertainment of his guests in the evening and the reception of callers during the day; a library that will be a family reading and letter-writing room, or a room for indoor amusement on rainy days, and at the same time serve the owner as a quiet retreat where he can, when he desires, attend to his commercial correspondence or receive a business caller. A billiard room is desired, large enough to contain a full-sized table and have a platform at the end wherefrom guests may watch the game. The dining room must be sufficient to seat eight guests besides the adult members of his family, and a wide veranda must extend the full length of one side of the house, preferably the east or southeast. The second floor must contain a large sleeping apartment for the owner and his wife, a bedroom for his daughter, and a nursery communicating with both the owner's room and the nurse's room. There must also be two large guest chambers, somewhat separated from the family apartments, but convenient to the main stairs; and in a wing apart from the main house must be provided, over the kitchen, etc., separate rooms for four servants and a housekeeper—the servants being a cook, laundress, waitress or maid, and a butler—two bathrooms being arranged on the second floor, one for the family and one for the servants.

As the house is to be occupied late into the fall season and possibly through the winter holidays, ample provision must be made for heating it, and open fireplaces are to be built in all the principal rooms of the first story, in addition to the furnace in the cellar.

**96.** Before laying out the plan, we must first consider the principal rooms and determine upon their sizes. The dining room is required to seat eight guests besides the owner's family, or eleven in all, and according to our rule the length of the dining table would be 5 × 2 ft. 4 in., or 11 feet 8 inches. Adding to this length 2 feet for the necessary armchairs at the head and foot of the table, and a passageway of 3 feet 6 inches for service at each end, we have a total length required for the dining room of 22 feet. But there is to be a fireplace in the room, and if we place this at the end, which is the best place for it, we must allow 2 feet more to accommodate the hearth.

A dining table nearly 12 feet long should be about 5 or 6 feet wide, and with proper allowance for chairs and a passageway behind them, we find the dimensions of our dining room will be about 16 ft. × 24 ft. The next room whose dimensions are practically governed by absolute measurements, is the billiard room; it must be at least 15 ft. × 20 ft. The parlor, or drawing room, should be about the same size, or a trifle larger than the dining room, and its shape should be rather oblong than square, in a house of this character. The dining room, being 16 ft. × 24 ft., contains a floor area of 384 square feet, so that we can consider an area of about 400 square feet as adequate for the parlor. The library is usually governed by the number of volumes it is to contain; but as in this case it is to be used as a family room, it should be about the same size or a trifle less in area than the dining room. It should be borne in mind, in planning the library, that the bookcases will take off from 16 inches to 18 inches all around the room, and that a library table about 4 ft. × 6 ft.

will occupy the center. Therefore, allowing about 5 feet 6 inches clear space between the library table and bookcases for chairs, etc., and assuming the bookcases to project 18 inches from the wall, we have for the library a room 18 ft. × 20 ft., which is ample for our purpose. When we consider the hall, which by the terms of the problem is to be large and hospitable, we will assume its dimensions to be not less than 16 feet wide, and that it extends the full depth of the house, with an entrance at each end. We cannot well determine its length until we arrange the rooms in the preliminary sketches, and decide upon the depth of the house.

**97.** The kitchen does not necessarily increase in size proportionately with the other rooms of the house; where there is but one cook employed, as is usually the case in private residences, she can prepare a meal for twenty persons in a kitchen of the same size as would be required to serve but six, and beyond a certain limit every increase in size of kitchen means more steps to be taken from table to dresser and dresser to range. Therefore, if we place a table 3 ft. × 4 ft. in the center of the kitchen, and allow 4 feet clear working space all around it, we have a space 11 ft. × 12 ft.; this space, which is found by experience to be a desirable one, should be clear of the dresser, the range, and the thoroughfare from the pantry to the room beyond.

The servants' hall is proportioned according to the number of servants, in the same manner as the dining room. The laundry should be preferably a long narrow room with its windows on one of the long sides directly opposite the stove. The tubs should then be at one end of the room and have windows over them. This keeps the washing at the tub end of the room, and the ironing can then be done facing the long window side, so that by simply turning around, the laundress may change her irons at the stove and continue her work with the fewest possible steps.

**98.** Having computed the approximate size and proportion of each room, we now prepare a preliminary freehand sketch of the first-floor plan, grouping the rooms and thoroughfares in such a manner as will bring each one in such a position that it will bear a convenient and desirable relation to the whole. This may require a number of sketches, each one of which is evolved on a different idea, and one similar to that shown in Fig. 98 may be arrived at only after hours of deliberation. This sketch has no scale and is simply a block arrangement to get an idea of the proper arrangement of the rooms we require. At *P* is the parlor, or drawing room, next to the library *L*, both of which open into the main hall *H*. The dining room *D* and billiard room *B* are apart from the main thoroughfare *H* and open upon the hallway *h*; then the servants' offices, such as the butler's pantry, kitchen, laundry, and servants' hall, are grouped in the extension and shown at *B P*, *K*, *L y*, etc. The veranda *V* and porte cochère *C* are located as shown. With this sketch as a guide and the area or dimension of each of the principal rooms marked on its plan, we draw the scale sketches, wherein all the parts will appear in their true proportion and relation. As we proceed, many alterations and changes will be necessary, but we must carefully study the plans and keep before us a mental picture of each detail as it will appear both in the interior and exterior elevations.

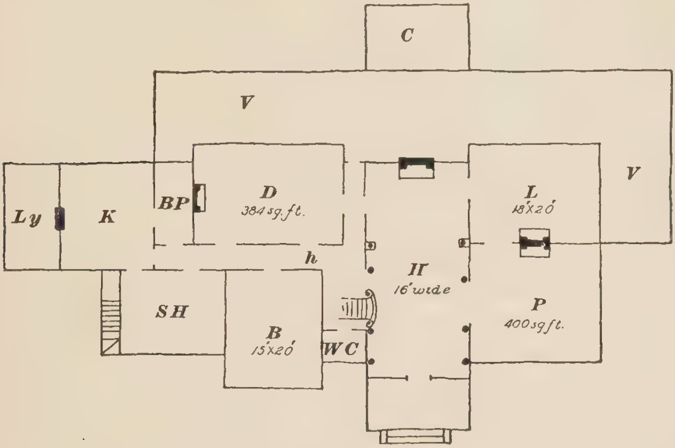
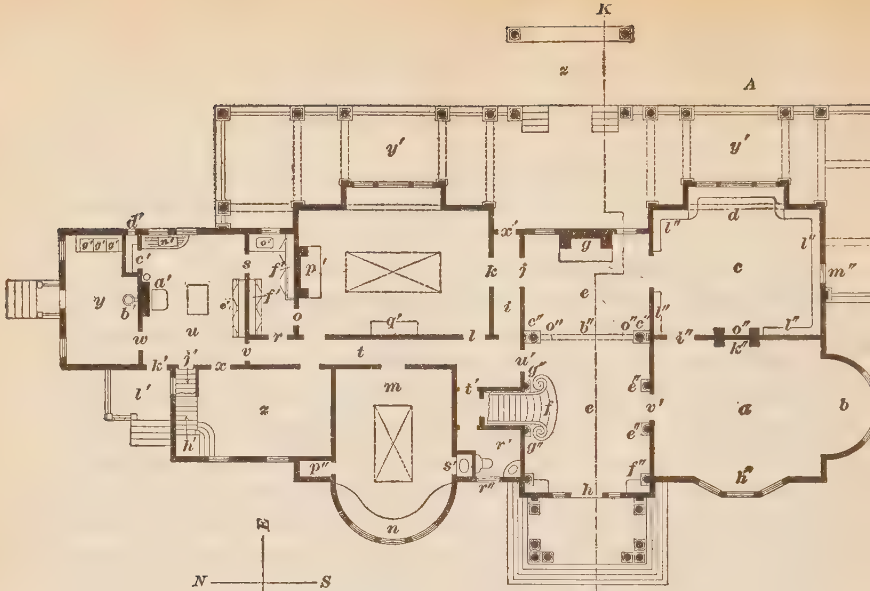


FIG. 98.

Repeated changes will be necessary before the work can be considered harmonious and satisfactory.

**99.** Plate II shows the sheet of plans as perfected, after all the necessary redrawings and retracings of its parts have been accomplished. The parlor *a* on plan *A* was originally drawn 19 ft. × 21 ft., or 399 square feet, but the room lacked character and the southern elevation was devoid of individuality, so the circular bay was added at *b*. The library *c*, originally planned 15 ft. × 20 ft., proved too narrow to admit all the furniture around the center table, so the square bay was thrown out at *d*. The hall *e*, 16 feet wide, is carried through the house, but is projected beyond the line of the parlor on the west end to give variety to the west elevation and also to emphasize the entrance. The stairs *f* and the fireplace *g* in the hall are so arranged as to give picturesqueness to the interior, as one enters the doorway *h*; while the hallway *i* is provided to prevent drafts through the main hall, when the door is opened to go out on the veranda; and from this hall is a large entrance *j* to the main hall, and on the opposite side an entrance to the dining room, as shown at *k*. It would be through these doors that guests would enter the dining room on the occasion of a more or less formal dinner, while the family would, when dining alone, be more likely to enter through the door *l*. A square bay is thrown out from the front of the dining room to correspond in the elevation with the bay *d* in the library. In detailing the interior of the library, provision will be made for a window seat. The billiard room *m* has in this plan assumed a rounded form on the west end; this is done in order to better diffuse the light over the table and prevent the shadows of the balls from falling in one direction. In this curve is also provided the platform *n* for spectators, and as the windows are high in the wall, the light is in no way interfered with. The butler's pantry is arranged next to the dining room, with its entrances to the dining room and kitchen at *o* and *s*, while at *r* is a door communicating with the hallway *t*. The kitchen *u* communicates with the hallway *t* through the door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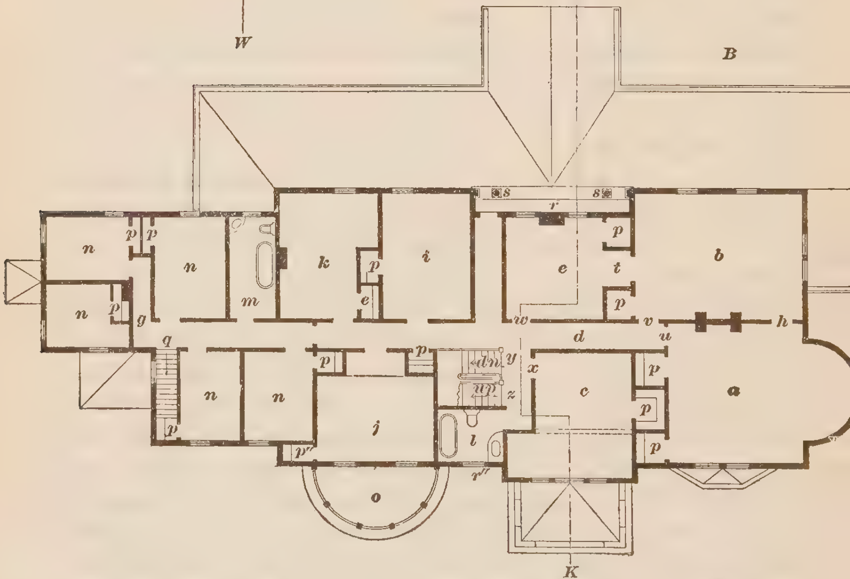
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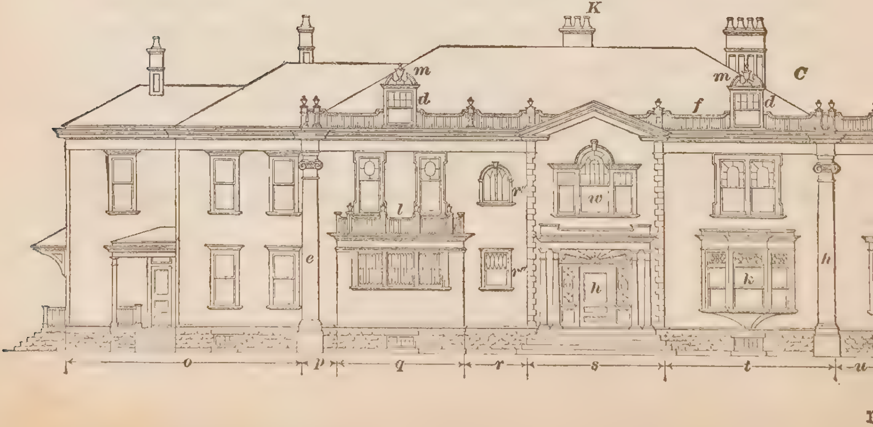
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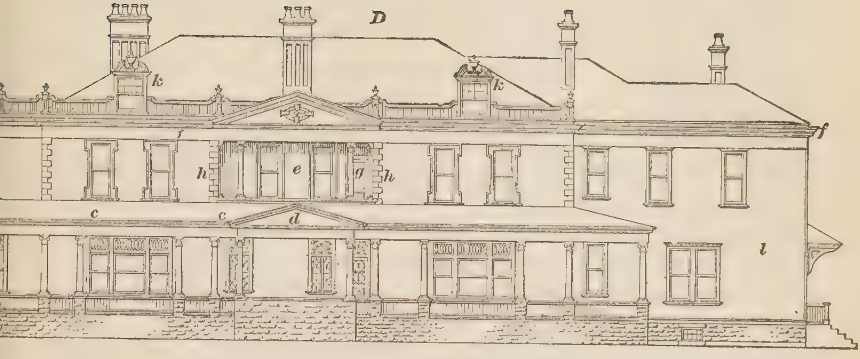
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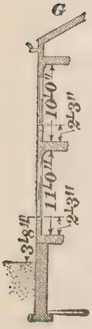
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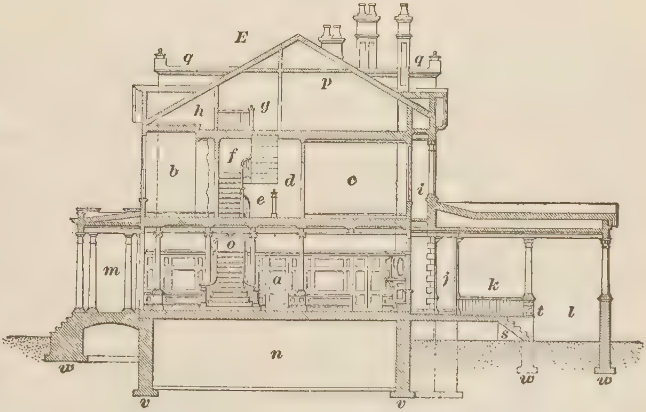
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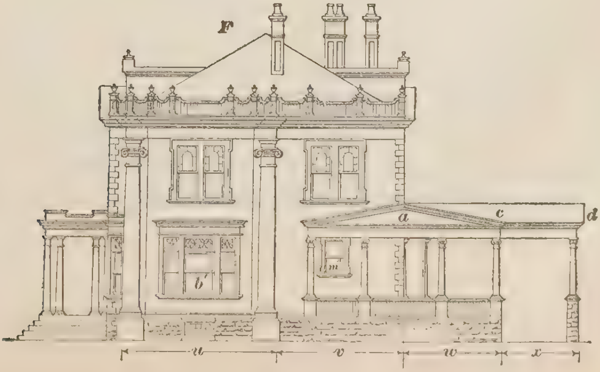
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*v*, and with the laundry *y* and servants' hall *z* through the doors *w* and *x*, so that part of the kitchen between the doors *v* and *w* is more or less of a thoroughfare and should contain none of the kitchen fixtures or furnishings. The range is placed at *a′* and the laundry stove is on the opposite side of the chimney at *b′*. The kitchen sink is placed in the angle at *n′*, while to the left of it is the storeroom *c′* with a ventilating window opening out at *d′*. The dresser is at *e′*, with two smaller ones in the butler's pantry at *f′*, thus giving plenty of working room around the kitchen table without interfering with the thoroughfare *v w*. The laundry is 10 feet wide and 17 feet long and has its tubs *g′* along the end, and is well lighted by windows overhead. At *h′* are the back stairs to the second floor opening from the servants' hall *z*, while at *j′* is a door opening from the kitchen to a flight of stairs leading to the cellar.

**100.** Returning to the entrance hall *e*, we will consider its interior treatment. Having adopted the style known as American colonial, we must bear in mind as we locate each door and window that the treatment of its details will form a feature in the decorative theme of the interior. At *b″* it is necessary to carry a heavy girder across the hall to support a partition which separates the nurse's room *e* from the hall *d*, shown on second-story plan *B*. We therefore support this girder upon two Ionic columns and pedestals *o″*, plan *A*, and back them up by wall pilasters at *c″*. Then, by locating the parlor door *v′* in the center of that room and flanking it on each side by the attached columns *e″* and *balancing* the design with the three-quarter column *f″*, we give the hall a dignified and monumental effect without detracting from its homelike and hospitable appearance. The symmetry of the design is effected by dividing the opposite side of the hall with similar half columns and pilasters, and establishing the stairway *f* between the columns *g″* opposite the parlor door *v′*. The rail of the stairs curves around in front of the columns *g″* and hides the lower part of them from view, hence the necessity of using pedestals, as explained in Art. **90,** *Architectural Design*, § 21.

The fireplace *g* gives the apartment a homelike appearance as one enters the door *h*, and its treatment can be made to assist greatly in the effect of the interior decoration.

The parlor *a* and library *c* are connected only by the single door *i*″, and the chimney at *k*″ is so placed that it can carry the flue from the fireplace in each room. In the library the bookcases *l*″ occupy all the available wall space. The small window at *m*″ is placed so that its sill is above the top of the bookcases. The relative height of this window above the others on the same floor is shown at *m*″ on elevation *F*.

**101.** The rooms in the second story *B* are arranged to bring as many of the partitions as possible over those in the first story, and we have the long center partition *g h* directly over a similar partition in the floor below. This arrangement, with a few subdivisions, gives us the required number of rooms set forth in our problem, and locates the owner's room at *a*, communicating through a door with the nursery *b*, which in turn connects by a passage *t* with *e*, which is the nurse's room. Each of these rooms communicates independently with the hall *d* through the doors *u*, *v*, and *w*. At *c* is the room for the owner's daughter, with its door *x* opening at the top of the main stairs *y*, and at *i* and *j* are two guest chambers opening on to the main hall *d*. The bathroom is at *l*, directly over the water closet *r*′ on the floor below, and this arrangement brings the windows of these toilet rooms on each floor in the recess of the elevation shown on *A*, *B*, and *C* at *r*″, making them, consequently, less conspicuous than they would be in a more prominent part of the facade. Room *k* is set aside as the housekeeper's room, and is so located that she can be in easy communication with her mistress's room *a*, or with the living rooms on the floor below, while the proximity of her room to the servants' rooms *n* renders her management of household affairs more simple and convenient. The servants' bathroom is located at *m*, directly over the butler's pantry, and at *q* is the back stairway leading to the servants' hall below.

Closets are provided for each room and the hall, as shown at *p*. At *o* and *r* are two balconies introduced to improve the character of the elevations.

**102.** In designing the elevations, it is well to develop *C* and *F* simultaneously, as they will be seen in conjunction; and before *F* is finished, commence on the elevation *D*, as *F* and *D* will be seen in conjunction from another point of view.

In laying out the plans *A* and *B*, we have predetermined certain divisions of the elevations—these are the projections of the main hall *e*, in plan *A*, and room *c*, in plan *B*—to form a distinctive central feature *s* of the elevation *C*, and to emphasize *h*, the entrance to the house. The recess at *r* has already been mentioned, and the reason of its existence explained.

The projection of the billiard room *m* in the form of a semicircular bay, was necessary to assure proper lighting of the table and space for the players and spectators, but there being no necessity for this appendage in the second story *B*, we finish it as an open deck or balcony *o*. The bay window is finished with a balcony rail *l*, and its general appearance in the elevation *C* is shown at *q*.

It now becomes necessary to balance this feature of the elevation with an equally important one on the opposite side of the pavilion *s*, and we construct a small projecting bay window *k*, as shown at *h″* in plan *A*. The corners of the house are finished with the two-story pilasters *e* and *h*, and the cornice resting upon them finishes the edge of the roof, while the parapet *f* gives an effective finish to the elevation.

In the nooks formed by the recession of the front wall, closets are arranged as at *p″*. Above the main divisions *q* and *t* of the elevation *C* are located two dormer-windows *d*, to light the attic. The broken pediments *m* on these dormer-windows are somewhat different from any we have hitherto illustrated, but they are prominent features in the later examples of colonial work. Circular or rounded pediments were common in the Italian and French Renaissance, as may be seen in the Farnese Palace, Château de Blois, and Louvre Palace, Figs. 94, 104, and 127, *History of Architecture*. Over the central window of the second story of the central pavilion of the Tuileries Palace, is a window with a curved pediment, which is broken on top to receive the carved coat of arms of the Medici family. The precedent thus established was the parent of many exaggerated forms. In the florid Renaissance, broken pediments were used in every available position. In colonial work, broken pediments were used over both exterior and interior door and window openings, and as a termination of dormers; in these positions they were used in many varieties of form, having both triangular and segmental outlines.

**103.** The wing *o*, shown in elevation *C*, Plate II, containing the offices—as the kitchen, laundry, etc. are sometimes called—and also the servants' rooms, in the second story, is treated very plainly, with no ornamentation or other means of rendering it conspicuous, as it is desired to have it express its purpose and position. At *u*, in elevation *F*, we have the projection of the semicircular bay of the parlor, and though this is essentially a detail of the south elevation, the arrangement of its window openings must be considered with the treatment of the west elevation, as they will frequently be seen together.

**104.** The eastern elevation *D* must rely for its effect almost entirely upon the treatment of the veranda and the arrangement of the windows. Considered in connection with the southern elevation *F*, we terminate the end of this veranda with a wide, low gable, or pediment *a*, and carry the moldings of the cornice *c* around the side to the pediment over the porte cochère *d*. The simplicity of the second story requires the introduction of the *loggia*, or balcony *e* (in the eastern elevation *D*), which shows also on the second-story plan *B* at *r*. Over this loggia the main cornice *f* is carried to form a pediment, which is supported by the two columns *g* and the quoins *h*, while the columns are also shown in plan *B* at *s*.

The dormers *k*, on elevation *D*, are similar to those on the western elevation *C*, and are located symmetrically in the center of the division of the facade on each side of the loggia *e*.

**105.** The transverse section *E* shows the elevation of the east side of the main hall at *a*, while the main stairs, shown at *f* in plan *A*, are here seen in elevation with the landing at *o*. These stairs land at *e* on the second floor, while at *f* are seen the stairs from the second story to the attic, landing at *g*. It is also seen on this section that the attic is not finished or even subdivided into rooms, but is left open for storage. The height of the ceiling *p* is set at 8 feet, and this determines the dimensions of our dormer-window *q*. At *b* on the section is shown the room marked *c* on the second-story plan *B*; the break in the ceiling at *h* is necessitated by the introduction of the *Palladian window* seen at *w* in the west elevation *C*. On the section *E* is the nurse's room *c*, and at *i* is shown the section through the loggia, marked *e* on elevation *D*. At *l* is shown the porte cochère, and at *t* is a step so placed that a person can enter the house from a carriage without stepping upon the ground, while the steps *s* are arranged for foot travelers. At *v* are the foundations of the main house, which are carried down below the bottom of the cellar *n*, and, as shown in the elevations, are constructed of stone.

The foundations of the porch and the veranda are shown at *w*; they are carried down about 4 feet below the ground line, so that the footings will not be affected by frost. As stated, the section shown at *E* is taken through the front entrance gable and the loggia gable; but, in order to show the details of the cornice, a section of the front wall is shown at *G*, giving the story heights and other details. The section *E* is taken on the line *KK*, as shown in plans *A* and *B*.

## OFFICE BUILDINGS.

**106.** The rapid increase of commerce and trade during the nineteenth century, due to improved methods of transportation and communication, and the concentration of business offices, have been the cause of a new architectural creation—the modern office building. In large cities, such as New York and Chicago, where land is exceedingly high priced, it has been necessary to erect office buildings whose height is greater than anything ever before erected for a similar purpose. In Chicago, the Masonic Temple is twenty stories in height and stands 302 feet above the curb line; in New York, the World Building is over 309 feet; the Manhattan Building is 326 feet; and the new Park Row Building over 400 feet in height.

As the methods of construction in these gigantic buildings are fully explained in *Architectural Engineering*, we will confine ourselves here to the discussion of the design from a utilitarian standpoint.

**107.** The elements to be combined in the successful office building are: (1) Ease of access; (2) good light; (3) good service; (4) pleasing location and surroundings; (5) the maximum of rentable area consistent with true economy; (6) ease of rearrangement of offices to suit tenants; (7) minimum of cost consistent with true economy. The first four of these elements are of particular interest to the tenant, while the last three of them concern both the landlord and the tenant. While at first sight it might seem as though the two interests were antagonistic, second thought will readily show that the landlord who sacrifices his tenants' interests, to a certain extent injures also his own—by reducing the value of the space he has to rent. On the other hand, the landlord's interests must not be sacrificed to those of his tenant, or he may be unable to secure a proper return for his investment.

**108.** **Ease of access** can be readily secured whether the building be low or high, the difference being simply in the elevator system; in fact, the solution of the access problem depends upon the elevator system almost entirely. The elevators should be so placed as to be reached directly from the street and only a few steps above or below the sidewalk. All the elevators should be grouped together, unless the building is very long, and so located as to front on two streets. In any case, the elevators should be so placed as to be readily seen by a person standing in the middle of the space devoted to them, so that when he wants a car, he can take the first. The character of the business in the building will determine the number of elevators, their speed, and the interval between trips. For ordinary office buildings a speed of 450 feet per minute and an interval of not more than 40 seconds between trips is considered good service. The number of elevators required will be governed by the number of offices on each story and the number of stories in the building.

An elevator car 5 ft. × 5 ft. is a convenient size, and at a speed of 450 feet per minute will serve 75 offices, if they are placed on more than two, and less than six, stories; where there is a larger number of offices, more cars will be required.

A building 25 ft. × 100 ft. which is more than four, and less than fifteen, stories high will require two cars; and in a 50′ × 100′ building there should be two cars up to eight stories, three cars for thirteen stories, and four cars for twenty stories. In a 100′ × 100′ building, four elevators will be required for ten stories, five for fourteen stories, and six for over that number.

Stairs in such buildings as these are of minor importance, as they are used only in the rarest emergencies.

There are, however, exceptions to these rules in the proportioning of elevators to the number of offices and stories —exceptions caused by the local characteristics of the towns wherein the buildings are erected, or by the peculiar conditions of the class of business prevailing in the immediate neighborhood of the structure. In large manufacturing cities it is almost universally the custom for the factory hands to stop work from noon until one o'clock in the afternoon, and to finish the day's labors at six in the evening; and the foremen, overseers, clerks, and even the proprietors of these manufacturing establishments usually observe the same regular hours. This system causes the meals to be similarly regulated throughout the city, even in the hotels, as traveling men soon learn that parties cannot be found at their places of business between the hours of twelve and one, nor after six o'clock, and utilize these hours to eat their own meals. Therefore, in a large and multi-storied office building in such a locality, the elevator service should be increased by at least 25 per cent., either by increasing the area of each car, or by the addition of an extra car to accommodate the rush which is sure to occur at the hours of leaving and returning to work. Another exception where an increase of access facilities is not only desirable, but absolutely necessary, is in a large financial center, where a building may contain many brokers' and bankers' offices, which require to have prompt and rapid communication with neighboring banks and offices.

**109. Good light** is of the utmost importance in every office building, and the offices should be so arranged that each one shall, at some part of the day, receive a portion of direct sunlight. Where the building is large and requires an interior court, the axis of this court should, when possible, be at an angle of $22\frac{1}{2}°$ east of north in localities near New York City, but varying according to latitude, in other sections. When this light court is open to the south, and of a long rectangular form, which is preferable to a square one, the sunlight will, during a part of the year at least, extend to the bottom of the court, which is invaluable for sanitation and illumination.

The light must be admitted to the offices through windows, and these must be made ample. A window 4 feet wide and 7 feet high, with its top not more than 1 foot below the ceiling, will light about 150 square feet of office space. Arched openings are to be avoided when possible, as they cut off some of the light.

**110. Good Service.**—Apart from the discipline and intelligence of the employes—characteristics which do not come into the architect's province—good service requires satisfactory toilet arrangements, heating, lighting, and ventilating considerations. Each floor of the building should have a toilet room containing one water closet for every five offices, and one wash basin and one urinal for every two closets. Besides these fixtures there should be a slop sink, placed in a compartment similar to the water closets, or a small cesspool, placed in the floor of each of the toilet rooms, for the use of the "scrubs." Where there is a toilet room for women, there should be double the number of water closets in proportion to the offices, and, if possible, a space should be provided for a sofa, and a connection left out for a small gas stove. This room should connect through a small lobby with the janitor's apartments. The toilet fixtures require for their accommodation the following dimensions on plan: For each water closet 2 ft. 6 in. × 3 ft. 10 in.; each urinal 2 ft. × 3 ft.; and each wash basin 2 ft. 6 in. × 3 ft. 6 in. This space of 3 feet 6 inches includes the minimum amount of room required by a person standing in front of the fixture.

**111.** Heating and ventilation should be considered together, as one depends so much upon the other, and a *direct-indirect* system is the most satisfactory for this class of work. A steam radiator of proper size standing under the window, and over a cold-air inlet near the floor, will not only warm the room sufficiently in the coldest of weather, but when the transom over the door is open and the cold-air damper at the floor is so turned as to permit the outside air to circulate between the pipes of the radiator, the circulation and ventilation of the air of the office will be nearly perfect.

The modern office building should be lighted by electricity. Where there is no public supply, provision must be made for a private plant in the cellar of the building. Each office should have a central chandelier with from two to four lights, all of which may be lighted or extinguished from a switch near the door; and there should also be a connection for a desk lamp, flush with the wall near each corner of the room.

**112. Rentable Area.**—The maximum rentable area consistent with economy must be considered in two parts, first as to the plan, and second as to the way the plan shall be carried into execution. First, there must be on each of the floor plans, the elevator well, the halls, the stairs, and the toilet rooms, each of which will require a given amount of space; and for economy of construction it is desirable that the various floors be made duplicates as far as possible, while for some of these features duplication is generally an absolute necessity.

The elevator shaft should be 1 foot larger in each dimension than the car, and should be placed at the center of the building or as nearly so as possible. The halls depend upon the size of the building to a certain extent, but for the usual 25′ × 100′ or 50′ × 100′ building they must be made as small as possible. The hall on the ground floor should be as direct as possible from the entrance to the elevators, and about 8 feet wide, with a space in front of the elevator the size of the well. On the upper floors, 3 feet 10 inches will be wide enough for the main halls, while 4 feet in front of the elevators will give ample room for the accommodation of passengers.

**113.** The stairs are used only occasionally and are in no sense to be considered as an ornamental feature in strictly utilitarian buildings. Occasionally, when the entire second floor is occupied by the offices of a large insurance or banking corporation, it is desirable to provide a grand staircase leading up to it, but the money that such a feature costs could certainly be spent to better advantage in other parts of the building. Under ordinary circumstances, a stairway 2 feet 10 inches wide is ample for ordinary purposes, and it should be placed at the end of the hall, or some other out-of-the-way place, and be made as plain as possible.

The toilet rooms should be placed either on a light well or on an exterior wall of the building, and must have good light and ventilation. As, frequently, there are tenants who desire to use an entire floor in the building, the toilet rooms should be so placed as not to interfere with the removal of all the partitions.

**114.** The economical depth of the offices is an item that must receive the closest study, the depth varying with the height of the ceilings, the width of the street, and the size of the windows. Except for special purposes, an office should not be more than one-third greater in depth than in height, and 16 feet is about the average limit, as any depth beyond that does not materially increase the rental value of the average office. A good standard size for an office is 150 square feet, and if the plan shows the room about 10 ft. × 15 ft., we have this standard size. Any tenant desiring a larger office can easily take down the partition and double the area. Where the light is particularly good, offices may be larger, especially where the building is large or the business requires it. This consideration of office depth limits also the useful size of a lot, as may readily be seen. There is a point where the extra size can only be used for court space, or in uselessly increasing the size of the offices.

**115.** In Figs. 99 to 104 we make practical application of the principles above set forth. In Fig. 99 we have the plan of one of the upper floors of an office building designed for a 25′ × 100′ corner lot and constructed on the skeleton-frame system, explained in *Architectural Engineering*.

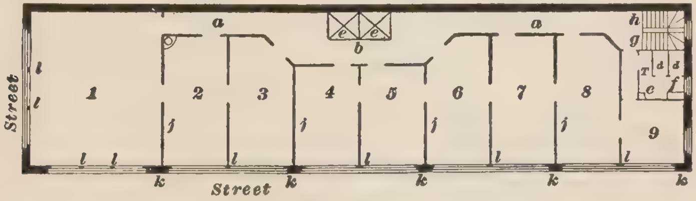

FIG. 99.

The elevators *e* are here placed in the center of the depth of the lot, against the inner wall or dark side of the building. The hallway is 3 feet 10 inches wide at *a*, but in front of the elevators it widens out to 4 feet at *b*. The stairs descending at *h* and ascending at *g* are, as before stated, seldom used in a multi-storied building, and consequently are located in the rear of the building, entirely out of the way, as is also the toilet room *T*. According to our rule, we would require for the nine offices on such a floor, two water closets *d*, *d*, one basin *f*, and one urinal *c*. All the offices in such a building are light, as the windows open directly on to the street. The widths of the offices are determined largely by the construction of the building (or, vice versa, the construction may be fixed by the predetermined extent of office areas, as explained in *Architectural Engineering*), and the partitions *j* are in fixed positions and cannot be changed in any floor, as they come in line with the columns of the steel construction. These columns are, of course, concealed in the piers *k*, which are the only masonry lines on the front of the building, except the covering for the girders between stories. An immense window area is thus obtained, which is broken only by the small cast-iron mullions *l*, and thus the maximum amount of light is secured for each office.

**116.** In Fig. 100 we have a lot of the same size, but in the center of the block instead of on a corner. It is, therefore, necessary to make a break in the side of the building, as at *s*, *s*, to form a light shaft, but the rooms on the lower stories will be quite dark at all times, as we can afford to reduce our building only 5 feet in width in order to secure this shaft, and special attention must be given to the convenient and liberal arrangements for artificial light in these

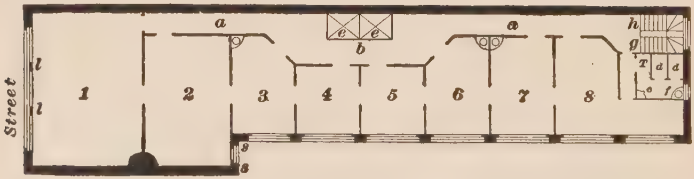

FIG. 100.

lower stories, to compensate for the lack of sunshine. The reduction in the width of our building by the encroachment of our light shaft will also change somewhat our system of construction. All the rooms on the light shaft in Fig. 100 should be wider than in Fig. 99, in order to bring their average area up to the standard. This reduces the number of offices on each floor and correspondingly cuts down the rental income of the building. But as a middle-block lot is not as valuable as a corner lot, and as a middle-block building has but one front to be built, while a corner building has two street fronts, it is not to be expected to derive as large an income from an interior building as from a corner building, as there is not nearly as much money invested, and these difficulties therefore equalize themselves. The hallway at *a* and *b*, the elevators *e*, the stairs *g*, *h*, and toilet room *T*, and the fixtures *d*, *c*, *f* are similar in size to those shown in Fig. 99.

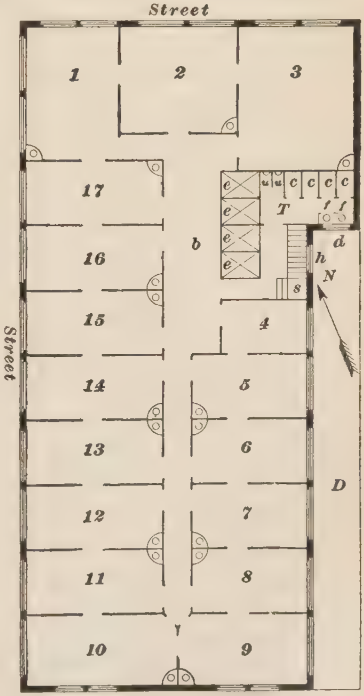

FIG. 101.

**117.** In Fig. 101 we have a plan of a building designed to cover a corner lot 50 ft. × 100 ft. In this case the elevators are placed towards the front of the building, thus shortening the length of the wide hall on the ground floor and economizing floor space for offices.

On the east side of the building is arranged a court *D* through which light is secured to the offices on that side; as the court is left open on the south, considerable sunlight will enter it during the middle of the day. The space *b* in front of the elevators *e* is of liberal dimensions, which allows passengers plenty of room to stand while waiting for a car, without interfering with the entrance to, or egress from, the adjacent offices. The stairs *s* and the toilet room *T* are placed behind the elevators and in a space that would be of little value for renting purposes, owing to the insufficiency of the light. The windows *h* and *d*, while not giving much light, will be invaluable for ventilation. As there are seventeen offices on this floor, three of which are unusually large, we provide, according to our rule, four water closets *c*, two urinals *u*, and two basins *f*, as shown on the plan, besides a basin which is placed in a corner of each office, with the exception of room *4*. If the plan was to be utilized for a lot in the middle of a block, the only alterations to be made would be to arrange another court on the west side of the building and duplicate the plan as here designed for the east side, except that two extra offices could be arranged in the space occupied by the elevators, toilet room, and stairs.

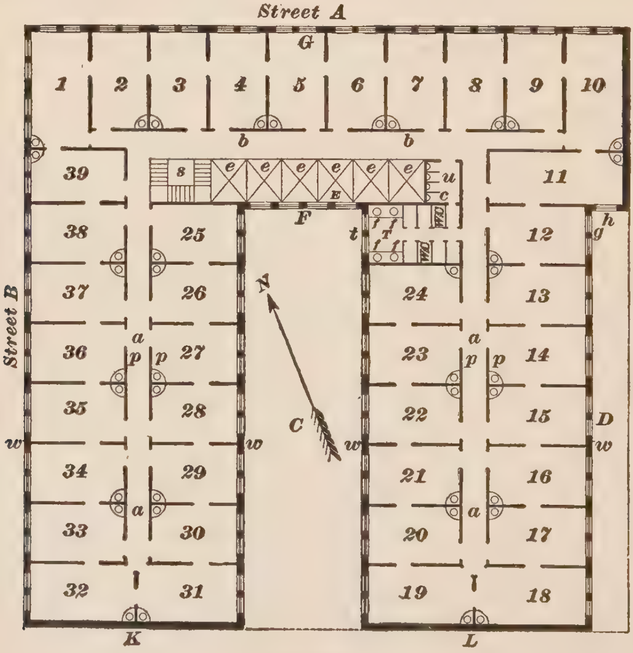

FIG. 102.

**118.** In Fig. 102 we have a plan for a building 100 ft. × 100 ft. on a corner lot, with a large light court *C* in the center, and a smaller court *D* on the east side. In proportioning these courts, in all cases and especially in a structure of this size, it is very important to have them as large as possible, in order to secure an abundance of light and air, and at the same time they must not be so large as to waste space that would otherwise be available for renting. In this case, our building is 100 feet wide from east to west, and we can allow about 15 feet for the depth of each of the offices, so that from east to west we have four offices of 15 feet each, or 60 feet; four walls *w* of 1 foot each; four partitions *p* of 6 inches each, and two halls *a* of 4 feet each, or a total of 74 feet of actual building; thus leaving 26 feet of the width which can be used as light courts. If we make the central court 19 feet and the east court 7 feet, we have arranged to use the allotted space economically, and can now proceed to divide up the offices.

**119.** The six elevators *e* are arranged along the main corridor *b*, and the offices opposite them, along the main street front, are designed 16 feet deep, to bring their floor area up to the standard, as they are less than 10 feet in width; the corridor *b* is 5 feet 6 inches in width, and the elevator shaft is 6 feet 6 inches deep, so we have, with the thickness of the partitions, 29 feet from the inside of our front wall *G* to the wall back of the elevators *c*, which gives us the inside line of the light well at *E*. After subdividing the wings *K* and *L*, we find we have to provide toilet arrangements for thirty-nine rooms. This will require eight water closets *W C*, four wash basins *f*, and four urinals *u*. The closets and basins are placed in the toilet room *T*, and are ventilated through a window *t*, while the urinals are placed in an apartment by themselves, and are ventilated into the main toilet room *T* through a small window *c*. The stairs *s* are conveniently placed and occupy space that would be of little value for renting purposes. The toilet room in this case is not located in the space occupied by room *11*, which would correspond with its position in Fig. 101; as shown on the plan the window *h* is very close to the office window *g*, and by placing the toilet room in room *11*, the rental of room *12* would be depreciated. Another objection would be that the single window *h* would not be large enough to sufficiently ventilate a room containing so many plumbing fixtures as are shown in *T*.

**120.** If this building were in the middle of a block instead of on a corner, two solutions to the problem would present themselves, according to circumstances. If the building were to front on street *A*, the best thing to do would be to design, on the west side of wing *K*, a court similar to court *D* on wing *L*, and keep the general arrangement precisely the same as before. But if the building were to front on street *B*, the most satisfactory plan would be that shown in Fig. 103.

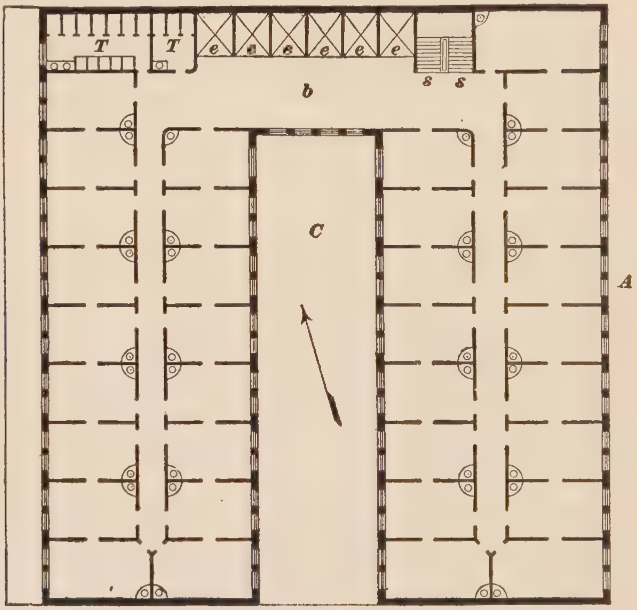

FIG. 103.

**121.** In Fig. 103 we have a light court *C* running $22\frac{1}{2}°$ east of north as before, but in this case it is parallel with the front of the building, which is at *A*, and all the office windows face practically east or west. The elevators *e* are against a blank wall, and the corridor *b* in front of them is well lighted through the windows facing the court *C*. The toilet rooms *T*, *T* and the stairs *s* bear the same relative position to the elevators as they did in Fig. 102, but are changed over to the dark side of the hall, so that the lightest portions of the building may be utilized for renting.

**122.** We have not illustrated a building with a frontage between 50 feet and 100 feet, as any size between those limits would present no new feature or even advantage over the $50' \times 100'$ plan, except in increased light courts and a slight enlargement of the offices.

**123.** The halls in these buildings depend for their light almost entirely upon the transom sashes over, and the glass panels in, the office doors; therefore, the upper panel of the doors should always be of ribbed or other translucent glass, and a liberal transom sash (hinged or pivoted) should be placed in each doorway. The passages may be rendered lighter by placing a range of sash openings in the partitions in line with the transom sashes over the doorways.

The courts and light shafts should be faced with white or gray enameled brick, to insure the reflection of the maximum amount of light into the offices. The halls, corridors, and toilet rooms should have tile or cement floors, while the offices should be floored with the highest grade of quartered Georgia-pine flooring at least $1\frac{1}{8}$ inches thick.

In buildings where the business carried on is of a character that requires the receipt or delivery of large cases of goods, it is necessary to provide, in addition to the regular service, a freight elevator, whose size and capacity cannot here be given, as it would depend entirely upon local circumstances.

**124.** The exterior of the modern office building is governed almost entirely by the construction, the main object being to secure all the light possible and create a design that will reflect credit upon the projector, while it neither increases the expense nor interferes with the utilitarian points of the construction. In skeleton-frame buildings the reveal of the windows is necessarily slight, while heavy projections, such as cornices and string-courses, are almost impossible, but the vertical lines may be divided by strongly emphasized horizontal courses, and the plainest structure may express architectural character of the strongest kind by the judicious arrangement of a few exterior details.

The design of the elevations of a building should express three general divisions: the *basement*, the *superstructure*, and the *roof*, or, if in columnar treatment, the *pedestal*, the *column*, and the *entablature*. This application of the term "basement" is not in the same sense as its general acceptance; namely, that portion of the building which is below the ground line; but, as applied to the elevations, the basement of the building is the lower division upon which the superstructure appears to rest. The basement may be subdivided into several stories, but the treatment of the elevation must be such as will group them so that the eye will consider them as one mass. This will be more clearly understood by reference to Fig. 104, where *A* may be considered the pedestal, *B* the shaft, and *C* the entablature. In some buildings the basement is built of rock-faced ashlar, which gives a bold and sturdy expression to it, while the superstructure is rendered lighter by finishing it with a clean-cut stone. The roof or cornice should be carried up to give a fitting crown to the whole structure, and should contain the stories assigned to it, without having the internal effect of an attic or garret.

In many office buildings there are several stories below the street line, consisting of the basement floor (which is the first story below the sidewalk), the cellar, and often several subcellars. When structures have to be erected to such great altitudes as are many modern mercantile buildings, it is frequently necessary to excavate 50 and sometimes even 60 feet to secure a sufficient and stable foundation.

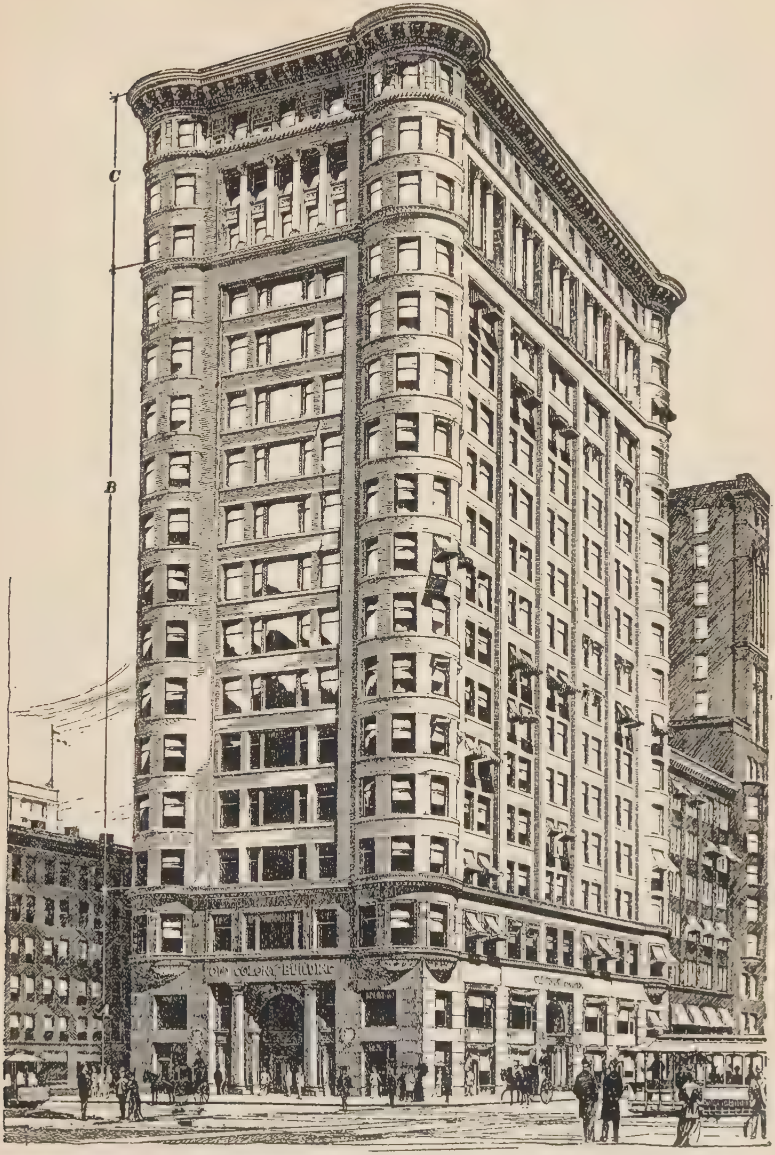

FIG. 104.

**125.** The conditions of the soil, bed rock, or sand beneath a building frequently make it necessary for the architect to entirely change his foundation plan and general system of support. It is, therefore, not only desirable, but very often absolutely indispensable, that the architect should have borings made on the site of the proposed building, so as to determine the character of the strata. This question of foundation is a vital one, as on it depends not only the permanence and durability of the structure, but also, very largely, the cost, convenience, and arrangement and economy of administration. It is down among those piers and walls of the foundation that much of the machinery for water supply, elevator service, electric lights, and steam heat will be located; the necessary storage room for coal and other supplies, with room for extra pieces of machinery, tools, and a workshop, must also be considered; and, unless conveniently located, much time may be lost or extra help required to satisfactorily conduct the work of the building.

**126.** The mechanical devices resorted to in building foundations under special difficulties are described in *Masonry* and in *Architectural Engineering*, but the consideration of just what means will be required to accomplish certain ends must be given full attention at the time of the planning of the first floor and basement. Whether the building is to be of skeleton-frame or solid-masonry piers, the location of the foundations of these piers must be determined before the upper work on the building is laid out, in order to concentrate each load and weight proportionately. If examination has proved that the soil upon which the building is to stand will carry a load of 2½ tons per square foot, then the ultimate load in tons of each column, pier, and wall must be divided by 2.5 in order to determine the area necessary for each part of the foundation. The greater the accuracy of these calculations, the more stable and durable will be the building. Every building will settle somewhat, and the great problem for the architect is to proportion its parts in accordance with the sustaining value of the soil, so that each and every part will be subjected to a uniform settlement. The irregular settlement of a large building, even though the variation is slight, will cause the plaster to crack, doors and window sashes to bind in their frames, or be opened or closed with more or less difficulty, floors to sag out of level, and, in many cases, the pipes which are carried throughout the house for gas, water, or steam to be *trapped* and even broken. The uniform settlement of a building is, therefore, a matter of the gravest importance, and demands the closest attention.

**127.** In nearly all structures, the ground floor, or the one next to the street, is of the most importance, and having arranged this to suit the requirements of the problem in the planning of rooms and the construction of the foundation, we proceed to the floors above and subdivide them according to the necessities of the case. This subdivision may probably require us to make changes in the arrangement of the first floor, and these changes may entail others in the foundation; so that the least alteration in the arrangement of any of the plans must be duly considered with reference to its bearing on the others.

It is customary in the offices of the best architects to lay out the first-story plan according to the requirements of the utilitarian purposes of the building, and then to lay over this drawing a sheet of tracing paper and draw the basement, or foundation plan, arranging the piers, columns, and interior walls under the points which require support. If some of these points of support occur upon soft or otherwise undesirable portions of the ground, we may have to resort to the system of cantilever foundations, or so change our first-story plan as to bring the load over a more secure area. In either case an alteration of the foundation plan will be necessary, which may cause frequent tracing and retracing before the plans can be made to meet the requirements of utility, strength, and beauty.

**128.** Having arrived at a satisfactory arrangement of the foundation and first-story plans, we now proceed to the second story, and having subdivided this into rooms and corridors, stair wells, and elevator shafts, as required by the problem, we discover that in order to secure rooms of the required size and proportion, and at the same time keep all partitions over one another, we must make some changes in the first-floor plan. Before we do this, we must study how such changes will affect the foundation plan, as that, too, will require alteration. In this rearrangement we have three plans to bear in mind, instead of two, and when the point is settled, and we start the third-story plan, the same difficulties may have to be settled again and again. Thus, when each floor has been satisfactorily planned, proper consideration must be given to every structural detail; this is an absolute necessity, as each structural feature is dependent more or less upon the other. A building, like a fabric, must be well and compactly bound and knit together, each and every part must be duly proportioned to the work it has to do, and strength, durability, and beauty must be present before it can be considered a successful architectural conception. This success can only be secured by assiduous study and constant perseverance.

While the plans have been in progress, and frequent alterations have been made, we have been constantly considering the effect to be produced in the elevation by each of these changes, and, consequently, have in mind a general idea of how the elevation or elevations will appear. This mental picture will include the general treatment of each of the portions or divisions of the facade referred to as the basement, superstructure, and roof, and we will be enabled to draw a rough freehand sketch of it, from which we can "work up" our scale elevation. The same rule of practice will be used as in the planning, and by constant rearranging of parts, our elevation must be, not fitted to our plans, but made a part of them. The moving of a partition or the changing of a column may require the rearrangement of all the plans, but this must be done, whenever necessary, to accomplish the desired end.

**129.** Having completed the elevations, we turn our attention to the roof. If it contains several stories, provision must be made to light them by dormer-windows, which require to be shown in the floor plans, and having decided on the treatment of the roof in design, we have then to deal with the covering, so that the roof will be not only watertight, but strong, durable, and effective.

Whether this roof is to be of wood, covered with some selected roofing material, or whether it is to be of iron frame filled in with fireproof blocks, the problem of proper drainage and watershed will be the same.

Ample provision must be made to carry away all the rain or melted snow water that may accumulate upon the roof, and proper slopes be given to shed this water in the direction of the gutters which feed the leader lines. The amount of slope necessary for this purpose is very slight, but consideration must be made for extremes, and the pitch of a flat roof should always be in excess of the requirements. The necessary amount of pitch is also governed very largely by the materials used, as tile, slate, shingles, and similar materials which constitute a roof covering of several pieces, and require a pitch much steeper than do tin, tar, asphalt, and other homogeneous materials which constitute a roof covering practically of one piece.

This is all explained, however, in *Roofing*, and the only bearing the subject has here is in connection with its effect on the design of the elevation. In an office building such as is here described, the roof may form an important part of the design of the front elevation, in which case the covering material may be of tile or slate, and the question of color will be taken into consideration when the architect studies his design, forming thereby another element whose harmony or contrast will materially count in the general excellence of the composition.

There are many cases where the roof division of the elevation may not show the real roof at all, but be simply the upper part of what is really the front wall, treated in design to group with the roof in effect, as is the case with the so called Mansard roof, where a slight inclination from the perpendicular is given to the upper part of the front wall, and the windows therein inserted as dormers. The front is then covered with slate or tile and forms a part of the apparent roof, while the real serviceable roof is nearly flat, and usually covered with copper, tin, or tar and gravel.

**130.** Chimneys have frequently been made a prominent detail in the design of the roof, especially in those periods of the Renaissance style where the Gothic forms had not entirely disappeared. This is dependent, of course, upon where the chimneys occur on the roof plan, as they are sometimes too far back of the facade to be visible from the ground. In the periods referred to, the open fireplace was becoming a popular feature in all rooms, especially in residences, and as each fireplace required a separate flue, the chimneys were, in consequence, very numerous and very large, and played a prominent part in the establishment of character and variety to the roof.

It is seldom that chimneys are either large or numerous in an office building, as the steam-heating plant in the basement requires but one flue, and it is seldom desirable to have open fireplaces in offices, unless they are to be occupied by a club or association. If such is the case, however, the architect must clearly show on his floor plans just where these fireplaces are to be situated, and must provide ample space in the chimney breasts for all the flues to be carried up to the roof in as direct a line as possible.

Even where fireplaces are provided, steam generally furnishes the heating element of the building, and the architect must provide in his plans a proper place for each radiator, and take into consideration, when he is arranging his subdivisions on each floor, that the steam-heating pipes should extend in a direct line from the cellar to the top floor, and that a clear way provided for them will prevent much subsequent trouble and difficulty in running the pipes. The radiators must be as near the rising lines as possible, and while their efficiency is greater when they are on the cold side of the room, they must be so placed as to temper all the cold air as well as keep it in circulation.

**131.** Hospitals, schools, colleges, theaters, and all places of public assemblage require, in addition to the foregoing conditions which govern the plans, a careful consideration of the matter of ventilation.

The system of ventilation to be used must be decided early in the progress of the drawings, as it may be necessary to leave vent flues in the walls and provide an arrangement of rooms that will be conducive to the perfect circulation of the air.

**132.** Modern buildings are illuminated after nightfall by either gas or electricity, and, as the latter is subject to some uncertainty of action, it is usual to supplement it with proper fixtures for gas in case the electric lights fail to work. Gas fixtures require that the entire building be piped, and, as there must also be water and waste pipes, as well as electric wires, it is the usual practice to provide a *well*, or *shaft*, built of brick, next to one of the principal walls and extending throughout the building. This shaft contains all these pipes and wires, and besides preventing the cutting of floors and ceilings at numerous places to permit the pipes to pass through, it renders any damage, leak, or other difficulty easy of access and repair, as the shaft is open on each floor through an ordinary door.

**133.** Where a building requires a mechanical equipment, it is usually situated down among the piers and walls of the foundation; in large cities it is customary, in many cases, to hire or rent the steam and electric power from companies incorporated for that purpose. These companies bring the steam pipe or electric wires into the building in the same manner as do the gas companies, and the owner carries the steam or electric current throughout the building by means of his own pipes or wires, built in when his structure is erected. In cases where the owner is desirous of keeping this part of his service under his own control, it is necessary to provide in the basement of the building, a boiler room, an engine room, and a dynamo room. In hotels there may also be required a freezing room, or ice-machine room, where cold brine, or other fluid, may be pumped through pipes to refrigerators and wine cellars, while in hospitals such machinery is used to supply cold air to the wards and operating rooms during warm weather.

This machinery must not rest on any of the framed floors of a building, especially if it is to be of the skeleton-frame type, as every vibration or sound will be carried to every part of the structure by the ironwork. A separate foundation should be built for each engine, pump, dynamo, etc., except under special circumstances or where the engine and dynamo are combined on one bedplate.

## CHURCHES.

**134.** The city residence, the country residence, and the office building are the three most frequent problems in architectural design, with the possible exception of church building, and though it is with ecclesiastical buildings that architecture has been most intimately identified in past ages, no definite system can be laid out for the procedure relating to their design.

Next to a thorough comprehension of religious architectural history, there is probably no greater assistance to the church designer than a complete understanding of all the details of its service. In church building, architectural design might be called *applied architectural history*, as the history of the Christian church is a history of architectural advancement, and no style of architecture could ever be more appropriate to church work than the style which was developed when Christianity advanced.

The different denominations of the Christian church require different arrangements of plan to suit their different forms of service, and the details of their designs depend upon the history of the development of their peculiar forms of faith.

Appropriate church architecture, therefore, includes nearly every style except the Classic Revival, but the style selected for an ecclesiastical edifice may none the less be decidedly inappropriate, as each of the denominations or sects of the Christian religion is more or less intimately connected with a certain style of architecture. The Romanesque and Gothic styles were developed in cathedral building during the ages when there was one united Christian church—the Catholic Church—but with the period of the Renaissance there was a division of the church, and though there were many Roman Catholic churches built in the style of the Roman Renaissance, they were not as architecturally successful as those in the Gothic and Romanesque designs. In designing a church, it is necessary to be familiar with the forms of its ceremony, the history of its foundation, and the general character of its government. The Roman Catholic Church and the Church of England, or, as it is sometimes called, the Episcopal Church, usually have their edifices built in the form of a cross, as explained in *History of Architecture.* The Presbyterian, which was the recognized English church in 1648, and the Methodist, which was a secession from the Episcopal in 1727, have their edifices generally planned as simple rectangular lecture rooms which are devoid of the architectural adjuncts peculiar to other forms of service, the buildings being so arranged that the preacher or pastor can address the entire congregation from a platform or pulpit.

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## ARMORIES.

**135.** Another form of modern building in which the requirements of the design are more or less predetermined, is the armory or drill hall, which is erected in cities and towns for the purpose of drilling and quartering the volunteer or citizen soldiers known as the militia.

The specific problem in a plan of this class of building consists in the provision of a drill room large enough for the military evolutions of a body of men which may range from two hundred to two thousand; rooms are also required which must be sufficiently large to enable each company or subdivision of the regiment to form and prepare for drill, and such rooms require to be provided with individual lockers, or small closets, in number equal to that of the company. Arrangements must be made for the proper heating, lighting, and ventilating of the structure, and provision must also be made for a rifle range, janitor's rooms, coal storage, etc., together with such other conveniences as the circumstances may require. Besides the specific problem, there is a contingent problem which arises when the men require to be quartered in the building; this may occur either during the time of an insurrection or riot, or when the armory is being besieged by a mob of rioters, or after the regiment has returned from service and is quartered in the armory to await discharge.

Such conditions require not only that room be provided for the storage of blankets and bedding, with a kitchen for the preparation of meals, but that the walls shall be of sufficient strength to withstand the force of an attack, and that no areas, coal slides or other exterior pockets shall be formed, wherein the rioters might explode dynamite or bombs to the injury and displacement of the walls. The corners and projections of the building should be protected by turrets and towers, from the windows or roofs of which the besieged can shoot in at least three directions. Telegraph, telephone, and electric-light wires, if used, should enter the building through an underground conduit, so that communication cannot be interfered with by the besiegers, and the wooden parts of the building must be so protected that the mob cannot throw inflammable material upon it and set it afire. On the inside, every preparation must be made not only for vigorous defense, but also for confinement; therefore, in addition to the kitchen, there must be storerooms for food, while in a remote part of the building there should be a room where the sick and wounded may be cared for. A *postern*, or gate, more or less concealed on the outside of the building, must provide a means of egress and ingress for spies and messengers. Complete fire apparatus, including a quantity of hose and a pump to produce high pressure, should also be arranged, as in the event of a siege the city fire department would be powerless.

We can discern a similarity of circumstances, and consequently the appropriateness of the style of the medieval castle to the modern armory or military storehouse for arms and ammunition.

## EDUCATIONAL BUILDINGS.

**136.** Colleges, schools, seminaries, and other educational institutions are frequently designed in the Elizabethan style, though the specific course of instruction for which the building is erected will, in many cases, dictate a different style of treatment. The fact that during the Elizabethan period so many educational institutions were erected makes this style singularly appropriate to such a purpose in all English-speaking countries; but, again, the Renaissance, in general, is typical of an age of education and of mental advancement.

The period of the Renaissance is prominent in the world's history as the age during which the people emerged from the darkness and superstition of the middle ages to enlightenment and freedom. Previous to this era, none but a member of the clergy was able to read or write, but after its advent, schools were established everywhere, and systematic education, for the first time, became a part of the training of the young. Hence, in France, Germany, Holland, and Great Britain, we see the schoolhouse erected in the style of architecture that marks the early stages of Renaissance. Colleges devoted distinctly to the pursuit of classic studies are frequently erected in a strictly classic style, tempered more or less by the local peculiarities of the country in which it is found. Girard College, as shown in Fig. 134, *History of Architecture*, is an example of this, while the early style of Elizabethan schoolhouse prevails in England and Scotland at the present day.

**137.** Art galleries, museums, and libraries, also being institutions of an educational character, usually partake of the classic style of design for the same reason as do the colleges, though they are sometimes seen in the Gothic style, purely for local reasons.

Venice having been a great art center for many generations, and possessing a style of Gothic peculiarly her own, it is not strange that many modern buildings should pattern after her school. Then again, during the Gothic Revival period in England, all buildings were erected in the style which was then fashionable, and we find all periods of Gothic art revived and exhibited in the facades of the educational buildings of this period. It therefore follows that there is no fixed law governing the style of architecture appropriate for a building, it being only necessary that the purpose for which the structure is erected should be evinced in the design, and as certain styles of design have been intimately associated with certain institutions, it renders those styles desirable factors in giving an expression of *character* to the edifice.

Proportion of parts and outline of mass are also potent factors in determining this expression of character in a building, but unless these are combined with a correct interpretation of an appropriate style of architecture, they are sure to fail in conveying to the mind the desired idea.

## PUBLIC BUILDINGS.

**138.** Government buildings, such as capitols, city halls, court houses, etc., are nearly always designed in the classic style, although exceptions, generally due to local influence and fashion, may occur, such as the British Houses of Parliament, shown in Fig. 130, *History of Architecture.* The classic style is appropriate to such structures principally because the history of the modern system of civil government begins with the systems of Greece and Rome. The modern capitol or city hall is the seat of government, where laws are enacted that differ only in detail and not in principle from those promulgated by the government of the Cæsars. The court house is the structure where these laws are interpreted under discussion, and, as an adjunct to the seat of government, its architecture should be of a harmonious style. A prison or jail is frequently built in connection with the court house, and the latter must, therefore, be altered in style, in order that the buildings may appear as one structure, while at the same time each part shall show its specific purpose. The prison, being an edifice for the forcible detention and confinement of prisoners, naturally reminds us again of the embattled and curtain-walled environment of the feudal castle, and, indeed, such a style of architecture is decidedly appropriate to such a building, but most inappropriate for a modern court house.

It is, therefore, necessary to design our court building in a style that will express the dignity of the law and yet not be in total discord with our feudal Gothic jail. We, therefore, execute the design in the Gothic school of the period that prevailed just previous to the reign of Elizabeth, in England. We find a precedent for this in the numerous town halls or guildhalls that were erected in Holland and Belgium at this time, many of the details of which found their way and became prominent features in the Elizabethan school of design.

Town halls, as distinguished from the more dignified epithet of city halls, may also, on account of their precedent in the low countries, as Holland and Belgium are sometimes called, be appropriately designed in the Gothic style, but, as said before, the seat of government in a large city demands a dignity of treatment and a boldness of design thoroughly in keeping with the importance of its purpose. These examples are sufficient to show that a proper amount of consideration must be given to historical value, as well as to general architectural treatment, in the design of a building, and where an owner desires to erect a building in a particular style which is inappropriate to the purpose for which the structure is intended, it is the duty of the architect to explain to his client the incongruity, and endeavor to instruct him in the principles of expression, so that he may have a better conception of fitness and propriety.

# A SERIES

OF

# QUESTIONS AND EXAMPLES

## RELATING TO THE SUBJECTS TREATED OF IN THIS VOLUME.

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It will be noticed that the Examination Questions contained in the following pages are divided into sections corresponding to the sections of the text of the preceding pages, so that each section has a headline which is the same as the headline of the section to which the questions refer. No attempt should be made to answer any questions or to work any examples until the corresponding part of the text has been carefully studied.

# HISTORY OF ARCHITECTURE.

(ARTS. 1-178. SEC. 20.)

## EXAMINATION QUESTIONS.

(1) (*a*) What were the characteristic features of the feudal castles? (*b*) What rooms in the modern house plan are derived from the "great hall" of the castle?

(2) What is the name of the curved line by which the shafts of the Greek columns were diminished?

(3) What two Roman architects wrote treatises on the "Five Orders of Architecture"?

(4) What are the three general principles of construction upon which all architectural styles are based?

(5) (*a*) How many temples are united in the structure known as the Erechtheum? (*b*) Are their entrances on the same level?

(6) Describe the approach to the entrance of an Egyptian temple.

(7) How did architecture originate?

(8) Who was the architect of Trinity Church, Boston?

(9) (*a*) In what structure does the only perfect example of the Grecian-Corinthian column exist? (*b*) Into how many flutes is the shaft divided?

(10) Has the architecture of Egypt, Assyria, and Persia exercised much influence on that of Western nations?

(11) What is a baptistry?

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(12) (*a*) When was the foundation stone of the United States Capitol laid? (*b*) When was the building finished? (*c*) Under whose supervision?

(13) From what class of mankind does a commmunity originate?

(14) How many original styles of architecture are there?

(15) (*a*) Under whose reign was late French architecture especially active? (*b*) What were the principal buildings erected? (*c*) Who was architect of each?

(16) What is meant by the term astylar?

(17) To what architectural style does the Hôtel des Invalides belong?

(18) Where did the Christians first hold services of worship?

(19) Describe the term *character* as applied to a building.

(20) What are the female figures called that supported the roof in the temple of Pandrosus?

(21) What prominent American building was designed to resemble the Cathedral of Seville?

(22) In what form of structure did Greek architecture reach its fullest development?

(23) (*a*) What style of architecture is represented in the Church of the Madeline? (*b*) What American building resembles it somewhat?

(24) What are the characteristics of the Louis XIV period of French architecture?

(25) What nations made use of lintels to span openings?

(26) What characteristic differences are there between the Renaissance architecture of France and that of Italy?

(27) Of what is the Florentine school of Italian Renaissance most expressive?

(28) (*a*) Give the names of the Grecian orders. (*b*) Name the three principal parts of each order.

(29) For what purposes are buttresses required?

(30) Describe the châteaux of the Francis I period of French architecture.

(31) What is the most characteristic detail of all Gothic construction?

(32) What are the most interesting monuments of the French Renaissance?

(33) (*a*) What was the Acropolis at Athens? (*b*) How many gateways did it have? (*c*) What was the name of the principal one?

(34) (*a*) What is an entablature? (*b*) What are the names of the parts into which it is divided?

(35) Why were flying buttresses introduced?

(36) What does Pelasgic architecture present to us?

(37) Describe in detail the theory of Gothic construction.

(38) Describe in detail the theory of Byzantine construction.

(39) How was the apparent depression in the cornices of the Grecian temples obviated?

(40) From what source did the Greeks derive the design of the Doric order?

(41) In what respect do French cathedral doorways differ from those in England?

(42) (*a*) When huge pieces of stone were used in masonry, by what name was it known to the Greeks? (*b*) Why was it so called?

(43) What are the fundamental principles of Gothic construction?

(44) What were the first three edifices erected solely for the purpose of Christian worship?

(45) Where do we find the first examples of the voussoired arch in Europe?

(46) What important structures were erected in the medieval period besides the cathedrals?

(47) What are the most important architectural monuments of Egypt?

(48) (*a*) From what source did the Romans get their ideas for early architectural works? (*b*) Where did they borrow their later ideas?

(49) Describe the characteristics of the Venetian Gothic style.

(50) When and where did the Flamboyant style flourish?

(51) Describe the characteristics of the French Renaissance during the Henry IV period.

(52) What is meant by the term *placing columns in antis?*

(53) Why is the character of Gothic architecture in Italy different from that of northern Europe?

(54) How were openings covered in the walls of cyclopean masonry?

(55) To what country do we turn for the beginnings of architecture?

(56) What was Romanesque architecture?

(57) (*a*) When is a temple called *peristylar?* (*b*) When is it said to be *dipteral?*

(58) What is the principal Gothic cathedral in Italy?

(59) What difficulties were overcome by use of the pointed arch?

(60) Name two Byzantine churches in western Europe.

(61) What difficulties present themselves in building a Roman groined vault over an oblong space?

(62) What is the finest Renaissance palace in Rome?

(63) (*a*) What is a triglyph? (*b*) What does it represent?

(64) Who designed the Cathedral of St. Paul in London?

(65) Where do we find the first trace of Renaissance architecture in England?

(66) (*a*) What is plate-tracery? (*b*) What is bar tracery? (*c*) To what period does each belong?

(67) Can the attempt to Romanize the Greek orders be considered a success?

(68) What buildings represent in America the period of the Classic Revival?

(69) Describe a Hathor-head capital.

(70) Of what period is the ball-flower ornament characteristic?

(71) (*a*) Name the architectural order in which the columns rest directly upon the stylobate. (*b*) What is a metope?

(72) What period of French Renaissance architecture probably displays the most studied exterior design?

(73) What is the most prominent Grecian building in the Ionic order?

(74) What is a transept?

(75) What is an atrium?

(76) What are the names and dates of the three periods of Gothic architecture in Great Britain?

(77) What is the distinction between the architecture of the Renaissance and that of the Revival period?

(78) What French château possesses examples of design embracing the three principal periods of the French Renaissance?

(79) Why were the columns in Egyptian architecture so closely placed?

(80) Name two representative buildings of the Classic Revival period in France, in Germany, and in England.

(81) What is a pediment?

(82) What are the three periods of Renaissance architecture in France?

(83) (*a*) What was the largest Roman amphitheater? (*b*) What was its capacity?

(84) With what feeling is the Parthenon regarded by the entire art world?

(85) Where and by whom was the Italian school of Renaissance architecture founded?

(86) By what other name is the architecture of the Louis XIV period known?

(87) What American building represents the period of English Gothic Revival?

(88) What is the most important building in Great Britain in the Revived Gothic style?

(89) When and where did American architecture reach its climax?

# ARCHITECTURAL DESIGN.

(ARTS. 1–131. SEC. 21.)

## EXAMINATION QUESTIONS.

(1) What is the architectural purpose of moldings?

(2) In composing the design of any building, how should we consider the plan in relation to the other drawings?

(3) In modern work should the proportions and details of an order be followed exactly?

(4) What peculiarities are observed in the Doric order as used in the Theater Marcellus at Rome?

(5) What proportion should exist between the trim and the opening of a monumental doorway?

(6) What were the three original Greek orders?

(7) (*a*) What is the height of the pedestal of an order in comparison with the length of the column? (*b*) What is the height of the entablature?

(8) What method of plan drawing is usually followed in the offices of the best architects?

(9) What gave rise to the invention of the Composite order?

(10) Describe the structural difference between the Greek and Roman systems of ornamentation.

(11) How does architectural design differ from design in the mechanic arts?

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(12) What detail of the Greek Doric is retained at the present day as characteristic of the order?

(13) What three principles do the elements of beauty embrace?

(14) What is meant by (*a*) *axial symmetry?* (*b*) *balance?*

(15) If the total height, including pedestal, column, and entablature, is 12 ft. 8 in., what is the diameter of the column (*a*) in the Doric order? (*b*) in the Ionic order?

(16) By what is the student furnished with a standard of classic architectural proportion?

(17) How should a group of four or more members be treated in architectural composition?

(18) (*a*) Where did the Grecian-Doric order attain the zenith of its perfection? (*b*) Where, the Ionic order?

(19) What are (*a*) triglyphs? (*b*) mutules? (*c*) guttæ?

(20) (*a*) Describe the outline of a cyma-recta molding. (*b*) On what part of a structure is it generally found?

(21) What is a "bird's-beak" molding?

(22) Describe the form of the round columns of the Norman period.

(23) What three considerations must be satisfied before we take the first step in the composition of a design?

(24) What is meant by *unity* in architectural design?

(25) What is characterized as a monumental plan?

(26) (*a*) What is the characteristic feature of the Greek-Ionic order? (*b*) How many flutes has its column?

(27) What is the most perfect design in Greek architecture?

(28) (*a*) How many different moldings exist in classic architecture? (*b*) What are their names?

(29) What branch of mathematics is largely influential in determining the proportions of the medieval cathedrals?

(30) (*a*) In Gothic architecture, upon what did the architects depend to produce architectural effect? (*b*) How did Classic and Renaissance architecture differ from this?

(31) Give two examples of architectural edifices illustrated in *History of Architecture*, whose composition expresses a group of two.

(32) The difference of impression felt on entering French and English cathedrals, is due to what?

(33) To what does the architectural term *order* refer?

(34) (*a*) Were the Roman moldings enriched as artistically as the Greek? (*b*) What was the difference?

(35) How do the contours of the Greek moldings differ from the Roman?

(36) What term is given to the openings in Gothic windows?

(37) What is the fundamental beauty of a noble building?

(38) What is the element of real importance in the Byzantine style of design?

(39) Name two buildings, illustrated in *History of Architecture*, each of whose masses gives an expression of *unity*.

(40) What are the divisions between the openings of Gothic windows called?

(41) (*a*) How many classes of Greek moldings are there? (*b*) Describe each.

(42) What resources have we at our command that contribute to the expression of artistic taste in a composition?

(43) Describe the flutes of the Greek-Corinthian order.

(44) (*a*) Of what does an architectural order consist? (*b*) To what is it subject? (*c*) By what is it regulated?

(45) In early Gothic buildings, what relation does ornament bear to the construction?

(46) (*a*) What is intercolumniation? (*b*) What details of the Doric order affect the intercolumniation? (*c*) Why?

(47) What characteristics are imparted to a composition through its treatment with reference to light and shade ?

(48) (*a*) What orders did the Romans add when they adopted the Greek system ? (*b*) Whence were they derived ?

(49) (*a*) What Grecian-Doric monument has no triglyphs in the frieze ? (*b*) What is substituted for the triglyphs ?

(50) In a group of classic moldings, for what purpose is the *fillet* used ?

(51) With what instrument or tool were the early Norman moldings executed ?

(52) When is it desirable to use pedestals under columns ?

(53) What is meant by *breadth* and *dignity* in a design ?

(54) Why was an alteration of the Greek orders necessary before they could be adopted by the Romans ?

(55) Define the difference between (*a*) *delicacy or prettiness*, (*b*) *beauty*, and (*c*) *grandeur, or magnificence* in architecture.

(56) What are the names of the principal details of Gothic moldings ?

(57) (*a*) What is a pilaster ? (*b*) When are the sides of a pilaster diminished with entasis ?

(58) What works of architecture are celebrated for their beauty of proportion exclusive of ornament ?

(59) How did the Romans alter the Doric order ?

(60) What are *antæ ?*

(61) What building illustrated in *History of Architecture* derives its beauty from a large area of lighted surface, without any important shadows to break it ?

(62) What is an arcade ?

(63) How did the French and English architects each secure nobility of effect in their edifices ?

(64) What detail appears in each of the Roman orders that we do not find in the Grecian?

(65) Describe the capitals of the Perpendicular Gothic period.

(66) To what class of Greek moldings does the "bird's beak" belong?

(67) What is a colonnade?

(68) How did the systems of proportion differ in Greek, Gothic, and Renaissance architecture?

(69) What are the principal examples of the Roman-Ionic order?

(70) In grouping three important elements of any design, what considerations should be given their relative sizes?

(71) What proportions should exist between the voids and solids of an elevation with arched openings?

(72) Of what two general processes does architectural composition consist?

(73) What is an *impost?*

(74) What general rules should be observed in designing a stone balustrade?

(75) In designing a tower, how should the windows be arranged regarding size?

(76) (*a*) What is supercolumniation? (*b*) What rules govern the diameters of columns in supercolumniation?

(77) What is double composition?

(78) Describe the bases of the columns during the three principal Gothic periods (Early English, Decorated, and Perpendicular).

(79) What proportions should exist between the weight and support in trabeated openings?

(80) From whom did the Romans borrow ideas in their architectural designs?

(81) How did the Romans sometimes treat the fluting of their columns?

(82) (*a*) Describe the difference between Grecian and Roman Ionic orders. (*b*) Describe the capitals of the columns in the Temple of Concord.

(83) What is a modillion?

(84) Give a general rule for the proportioning of arched openings.

(85) What prominent building in ancient Roman architecture has unfluted columns?

(86) What is *arœostyle* intercolumniation?

(87) What distinction is made in the application of the terms *composition* and *design?*

(88) With what do the Five Orders of Architecture furnish us?

# ARCHITECTURAL DESIGN.

(ARTS. 1-138. SEC. 22.)

## EXAMINATION QUESTIONS.

(1) (*a*) What four elements should be combined in the plan and arrangement of an office building to make it desirable to tenants? (*b*) What three elements must be combined to make such a building a profitable investment for the owner?

(2) What are the conditions to be observed in the design of an armory?

(3) What does a practical plan comprise?

(4) (*a*) Name three kinds of Egyptian ornament. (*b*) Give an example of each.

(5) What considerations should be observed in locating toilet rooms in an office building?

(6) How many elevators will be required in an office building 100 feet by 100 feet, and twelve stories high?

(7) (*a*) In a building where there are fourteen offices on each floor, how many water closets will be required in the toilet room for each floor? (*b*) How many basins?

(8) What are the characteristics of the French Renaissance style?

(9) In the American colonies what strong contrast existed between the conditions of the people in the North and those in the South?

(10) What characteristic of Greek ornament was continued by the Romans but abandoned by the Byzantine artists?

(11) Into what periods is the Renaissance ornament of France divided?

(12) (*a*) What peculiarities are exhibited by the gables in Elizabethan architecture? (*b*) Whence was this form derived?

(13) What specific influences developed the peculiarities of Elizabethan ornament?

(14) What is the distinguishing characteristic of the Renaissance plan as contrasted with the Gothic?

(15) What detail of middle-age architecture is still prominent in the arrangement of the plan of French mansions?

(16) What is considered to be the best average size for an office?

(17) What three general divisions should be expressed in the elevations of a high building?

(18) What are the chief characteristics of the Elizabethan plan?

(19) At what speed, and how often, should the elevators run in a modern office building to give good service?

(20) Where should the stairs be placed in a modern office building?

(21) What is the elementary knowledge required to compose an appropriate church design?

(22) What is *polychromy?*

(23) What difference, in the use of sculpture, exists between Byzantine and Romanesque art?

(24) From what is the architectural ornament of the Elizabethan period derived?

(25) In what class of buildings do we find the most characteristic expression of Roman ornament?

(26) What is the essential difference to be considered in planning country and city residences?

(27) (*a*) In a small office building, how wide should the main hall be? (*b*) How wide should the upper hall be? (*c*) How wide should the stairs be?

(28) In what style of architecture are court houses, municipal buildings, capitols, etc. usually designed? Why?

(29) What style of architecture is intimately associated with educational buildings?

(30) What are the characteristics of pure Byzantine ornament?

(31) Describe briefly the characteristics of Early English ornament and its modifications during the Decorated period.

(32) What American flower does the Egyptian lotus blossom resemble?

(33) What were the characteristics of the house plan in Great Britain during the period of the Classic Revival?

(34) What prominent detail existed in the exterior of the house during the Classic Revival period?

(35) What historical American residence shows the adoption of this detail?

(36) What period in European history do the conditions of the Dutch settlement in America resemble?

# A KEY

TO ALL THE

# QUESTIONS AND EXAMPLES

INCLUDED IN THE

# EXAMINATION QUESTIONS.

It will be noticed that the Keys have been given the same section numbers as occur on the headlines of Examination Questions to which they refer. All article references refer to the Instruction Paper bearing the same section number as the Key in which it occurs, unless the title of some other Instruction Paper is given in connection with the article number.

To be of the greatest benefit, the Keys should be used sparingly. They should be used much in the same manner as a pupil would go to a teacher for instruction with regard to answering some example he was unable to solve. If used in this manner, the Keys will be of great help and assistance to the student, and will be a source of encouragement to him in studying the various papers composing the Course.

# HISTORY OF ARCHITECTURE.

(QUESTIONS 1–89. SEC. 20.)

(1) See Art. **91.**
(2) See Art. **25.**
(3) See Art. **110.**
(4) See Art. **1.**
(5) See Art. **30.**
(6) See Art. **7.**
(7) See Art. **1.**
(8) See Art. **171.**
(9) See Art. **32.**
(10) See Art. **20.**
(11) See Art. **51.**
(12) See Art. **165.**
(13) See Art. **1.**
(14) See Art. **178.**
(15) See Art. **123.**
(16) See Art. **21.**
(17) See Art. **122.**
(18) See Art. **48.**
(19) See Art. **1.**

(20) See Art. **30.**

(21) See Art. **172.**

(22) See Art. **20.**

(23) See Arts. **142** and **168.**

(24) See Art. **122.**

(25) See Art. **1.**

(26) See Art. **124.**

(27) See Art. **99.**

(28) See Art. **24.**

(29) See Art. **65.**

(30) See Arts. **112** to **118.**

(31) See Art. **72.**

(32) See Art. **112.**

(33) See Art. **33.**

(34) (*a*) See Art. **24.**
(*b*) See Art. **25.**

(35) See Art. **66.**

(36) See Art. **19.**

(37) See Arts. **65** and **66.**

(38) See Arts. **53** and **54.**

(39) See Art. **37.**

(40) See Art. **25.**

(41) See Art. **80.**

(42) See Art. **19.**

(43) See Art. **65.**

(44) See Art. **49.**

(45) See Art. **38.**

(46) See Arts. **90** and **91.**

(47) See Art. **5.**

(48) See Art. **39.**

(49) See Arts. **86** to **88.**

(50) See Arts. **70** and **82.**

(51) See Art. **121.**

(52) See Art. **21.**

(53) See Art. **83**

(54) See Arts. **18** and **19.**

(55) See Art. **3.**

(56) See Art. **50.**

(57) See Art. **21.**

(58) See Art. **88.**

(59) See Art. **64.**

(60) See Art. **58.**

(61) See Art. **63.**

(62) See Art. **108.**

(63) See Art. **25.**

(64) See Art. **134.**

(65) See Art. **131.**

(66) See Art. **70.**

(67) No.

(68) See Art. **168.**

(69) See Art. **11.**

(70) See Art. **73.**

(71) See Art. **25.**

(72) See Art. **123.**

(73) See Art. **30.**

(74) See Art. **49.**

(75) See Art. **49.**

(76) See Art. **70.**

(77) See Art. **139.**

(78) See Art. **116.**

(79) See Art. **11.**

(80) See Arts. **141** to **151.**

(81) See Art. **26.**

(82) See Art. **111.**

(83) See Art. **43.**

(84) See Art. **27.**

(85) See Arts. **95** and **96.**

(86) See Art. **111.**

(87) See Art. **169.**

(88) See Art. **160.**

(89) See Art. **177.**

# ARCHITECTURAL DESIGN.

(QUESTIONS 1–88. SEC. 21.)

(1) See Art. **69.**
(2) See Art. **24.**
(3) See Art. **66.**
(4) See Art. **56.**
(5) See Art. **105.**
(6) See Art. **40.**
(7) See Art. **67.**
(8) See Art. **24.**
(9) See Art. **66.**
(10) See Art. **55.**
(11) See Art. **1.**
(12) See Art. **41.**
(13) See Art. **9.**
(14) See Art. **28.**
(15) See Art. **67.**
(16) See Art. **39.**
(17) See Art. **23.**
(18) See Arts. **41** and **59.**
(19) See Arts. **42** and **43.**

(20) See Art. **71.**

(21) See Art. **84.**

(22) See Art. **128.**

(23) See Art. **1.**

(24) Grouping of parts so as to present an impression of singleness of mass.

(25) See Art. **30.**

(26) See Arts. **45** and **46.**

(27) The Parthenon.

(28) See Arts. **69** to **77.**

(29) See Arts. **109, 113,** and **115**

(30) See Art. **36.**

(31) See Art. **16.**

(32) See Art. **30.**

(33) See Art. **40.**

(34) See Art. **78.**

(35) See Art. **78.**

(36) See Art. **113.**

(37) See Art. **32.**

(38) See Art. **6.**

(39) See Art. **15.**

(40) See Art. **113.**

(41) See Art. **82.**

(42) See Art. **31.**

(43) See Art. **51.**

(44) See Art. **40.**

(45) See Art. **117.**

(46) See Arts. **86** and **88.**

(47) See Art. **32.**

(48) See Arts. **40, 52, 53,** and **66.**

(49) See Art. **42.**

(50) See Art. **70.**

(51) See Art. **119.**

(52) See Art. **90.**

(53) See Art. **34.**

(54) See Art. **55.**

(55) See Art. **11.**

(56) See Art. **124.**

(57) See Art. **99.**

(58) See Art. **35.**

(59) See Art. **56.**

(60) See Art. **44.**

(61) See Art. **32.**

(62) See Art. **91.**

(63) See Art. **35.**

(64) See Art. **53.**

(65) See Art. **128.**

(66) See Art. **84.**

(67) See Art. **92.**

(68) See Art. **37.**

(69) See Art. **59.**

(70) See Art. **17.**

(71) See Art. **93.**

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(73) See Art. **101.**

(74) See Art. **102.**

(75) See Art. **131.**

(76) See Art. **98.**

(77) See Art. **22.**

(78) See Art. **129.**

(79) See Art. **95.**

(80) See Art. **52.**

(81) See Art. **65.**

(82) See Arts. **59** and **60.**

(83) See Art. **64.**

(84) See Art. **97.**

(85) See Art. **63.**

(86) See Art. **87.**

(87) See Art. **2.**

(88) See Art. **39.**

# ARCHITECTURAL DESIGN.

(QUESTIONS 1–36. SEC. 22.)

(1) See Art. **107.**

(2) See Art. **135.**

(3) See Art. **53.**

(4) See Arts. **10, 13,** and **14.**

(5) See Art. **113.**

(6) See Art. **108.**

(7) See Art. **110.**

(8) See Art. **37.**

(9) See Arts. **69** to **71.**

(10) See Art. **15.**

(11) See Art. **36.**

(12) See Art. **67.**

(13) See Art. **48.**

(14) See Art. **63.**

(15) See Art. **61.**

(16) See Art. **114.**

(17) See Art. **124.**

(18) See Art. **66.**

(19) See Art. **108.**

(20) See Art. **113.**

(21) See Art. **134.**

(22) See Art. **19.**

(23) See Arts. **24** and **25.**

(24) See Art. **48.**

(25) See Art. **21.**

(26) See Art. **94.**

(27) See Arts. **112** and **113.**

(28) See Art. **138.**

(29) See Art. **136.**

(30) See Art. **24.**

(31) See Art. **26.**

(32) See Art. **11.**

(33) See Art. **68.**

(34) See Art. **68.**

(35) See Art. **70.**

(36) See Art. **78.**

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